Nexus®
1250/1252

ADVANCED PERFORMANCE POWER METER AND POWER QUALITY RECORDER

Installation & Operation Manual
Version 1.31
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Electro Industries/GaugeTech
1800 Shames Drive
Westbury, New York 11590

Tel: 516-334-0870 ◆ Fax: 516-338-4741
Sales@electroind.com ◆ www.electroind.com

"The Leader in Power Monitoring and Control"

Nexus® 1250/1252 Meter
Installation and Operation Manual
Revision 1.31

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Customer Service and Support

Customer support is available 9:00 am to 4:30 pm, Eastern Standard Time, Monday through Friday. Please have the model, serial number and a detailed problem description available. If the problem concerns a particular reading, please have all meter readings available. When returning any merchandise to EIG, a return materials authorization number is required. For customer or technical assistance, repair or calibration, phone 516-334-0870 or fax 516-338-4741.

Product Warranty

Electro Industries/GaugeTech warrants all products to be free from defects in material and workmanship for a period of four years from the date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, fax or call our customer-support department. You will receive prompt assistance and return instructions. Send the instrument, transportation prepaid, to EIG at 1800 Shames Drive, Westbury, NY 11590. Repairs will be made and the instrument will be returned.

Limitation of Warranty

This warranty does not apply to defects resulting from unauthorized modification, misuse, or use for any reason other than electrical power monitoring. The Nexus® 1250/1252 meter is not a user-serviceable product.

OUR PRODUCTS ARE NOT TO BE USED FOR PRIMARY OVER-CURRENT PROTECTION. ANY PROTECTION FEATURE IN OUR PRODUCTS IS TO BE USED FOR ALARM OR SECONDARY PROTECTION ONLY.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ELECTRO INDUSTRIES/GAUGETECH SHALL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING FROM ANY AUTHORIZED OR UNAUTHORIZED USE OF ANY ELECTRO INDUSTRIES/GAUGETECH PRODUCT. LIABILITY SHALL BE LIMITED TO THE ORIGINAL COST OF THE PRODUCT SOLD.

Statement of Calibration

Our instruments are inspected and tested in accordance with specifications published by Electro Industries/GaugeTech. The accuracy and a calibration of our instruments are traceable to the National Institute of Standards and Technology through equipment that is calibrated at planned intervals by comparison to certified standards.

Disclaimer

The information presented in this publication has been carefully checked for reliability; however, no responsibility is assumed for inaccuracies. The information contained in this document is subject to change without notice.

This symbol indicates that the operator must refer to an explanation in the operating instructions. Please see Chapter 3, Hardware Installation, for important safety information regarding installation and hookup of the Nexus® 1250/1252 Meter.

About Electro Industries/GaugeTech

Electro Industries/GaugeTech was founded in 1973 by Dr. Samuel Kagan. Dr. Kagan's first innovation, an affordable, easy-to-use AC power meter, revolutionized the power-monitoring field. In the 1980s Dr. Kagan and his team at EIG developed a digital multifunction monitor capable of measuring every aspect of power.

EIG further transformed AC power metering and power distribution with the Futura+ device, which supplies all the functionality of a fault recorder, an event recorder and a data logger in a single meter. Today, with the Nexus® 1250/1252 meter, the Nexus® 1262/1272 meters and the Shark® Series meters, EIG is a leader in the development and production of power monitoring products. All EIG products are designed, manufactured, tested and calibrated at our facility in Westbury, New York.

Today, EIG continues to maintain its standing as the world leader in power monitoring and power quality technology. Our meters are used world wide by the largest investor-owned electric power utilities, municipal governments, the Military, and industry. With over thirty years of experience, EIG prides itself on being an integral component to the goal of making electrical power distribution reliable and affordable.

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Chapter 1
Three-Phase Power Measurement

This introduction to three-phase power and power measurement is intended to provide only a brief overview of the subject. The professional meter engineer or meter technician should refer to more advanced documents such as the EEI Handbook for Electricity Metering and the application standards for more in-depth and technical coverage of the subject.

1.1: Three-Phase System Configurations

Three-phase power is most commonly used in situations where large amounts of power will be used because it is a more effective way to transmit the power and because it provides a smoother delivery of power to the end load. There are two commonly used connections for three-phase power, a Wye connection or a Delta connection. Each connection has several different manifestations in actual use.

When attempting to determine the type of connection in use, it is a good practice to follow the circuit back to the transformer that is serving the circuit. It is often not possible to conclusively determine the correct circuit connection simply by counting the wires in the service or checking voltages. Checking the transformer connection will provide conclusive evidence of the circuit connection and the relationships between the phase voltages and ground.

1.1.1: Wye Connection

- The Wye connection is so called because when you look at the phase relationships and the winding relationships between the phases it looks like a Y (Wye). Figure 1.1 depicts the winding relationships for a Wye-connected service. In a Wye service the neutral (or center point of the Wye) is typically grounded. This leads to common voltages of 208/120 and 480/277 (where the first number represents the phase-to-phase voltage and the second number represents the phase-to-ground voltage).

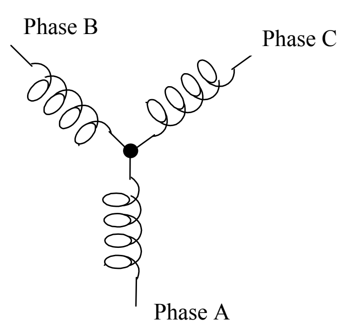


Figure 1.1: Three-Phase Wye Winding

- The three voltages are separated by 120^o electrically. Under balanced load conditions with unity power factor the currents are also separated by 120^o. However, unbalanced loads and other conditions can cause the currents to depart from the ideal 120^o separation.
  Three-phase voltages and currents are usually represented with a phasor diagram. A phasor diagram for the typical connected voltages and currents is shown in Figure 1.2.

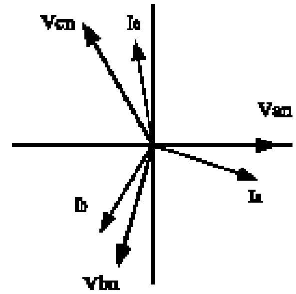


Fig 1.2: Phasor Diagram Showing Three-phase Voltages and Currents

- The phasor diagram shows the 120^{o} angular separation between the phase voltages. The phase-to-phase voltage in a balanced three-phase Wye system is 1.732 times the phase-to-neutral voltage. The center point of the Wye is tied together and is typically grounded. Table 1.1 shows the common voltages used in the United States for Wye-connected systems.

Phase to Ground Voltage	Phase to Phase Voltage
120 volts	208 volts
277 volts	480 volts
2,400 volts	4,160 volts
7,200 volts	12,470 volts
7,620 volts	13,200 volts

Table 1.1: Common Phase Voltages on Wye Services

- Usually a Wye-connected service will have four wires; three wires for the phases and one for the neutral. The three-phase wires connect to the three phases (as shown in Figure 1.1). The neutral wire is typically tied to the ground or center point of the Wye (refer to Figure 1.1).

  In many industrial applications the facility will be fed with a four-wire Wye service but only three wires will be run to individual loads. The load is then often referred to as a Delta-connected load but the service to the facility is still a Wye service; it contains four wires if you trace the circuit back to its source (usually a transformer). In this type of connection the phase to ground voltage will be the phase-to-ground voltage indicated in Table 1, even though a neutral or ground wire is not physically present at the load. The transformer is the best place to determine the circuit connection type because this is a location where the voltage reference to ground can be conclusively identified.

1.1.2: Delta Connection

- Delta connected services may be fed with either three wires or four wires. In a three-phase Delta service, the load windings are connected from phase-to-phase rather than from phase-to-ground. Figure 1.3 shows the physical load connections for a Delta service.

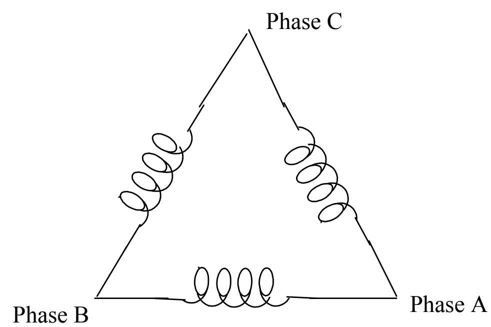


Figure 1.3: Three-Phase Delta Winding Relationship

In this example of a Delta service, three wires will transmit the power to the load. In a true Delta service, the phase-to-ground voltage will usually not be balanced because the ground is not at the center of the delta.

Figure 1.4 shows the phasor relationships between voltage and current on a three-phase Delta circuit.

In many Delta services, one corner of the delta is grounded. This means the phase to ground voltage will be zero for one phase and will be full phase-to-phase voltage for the other two phases. This is done for protective purposes.

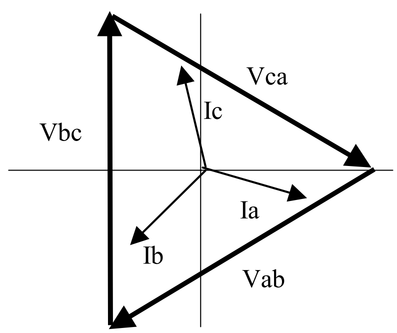


Figure 1.4: Phasor Diagram, Three-Phase Voltages and Currents Delta Connected.

- Another common Delta connection is the four-wire, grounded delta used for lighting loads. In this connection, the center point of one winding is grounded. On a 120/240 volt, four-wire, grounded Delta service the phase-to-ground voltage would be 120 volts on two phases and 208 volts on the third phase. Figure 1.5 shows the phasor diagram for the voltages in a three-phase, four-wire Delta system.

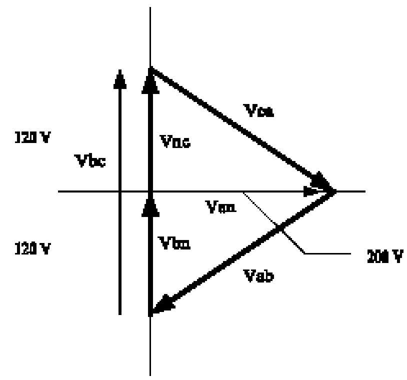


Fig 1.5: Phasor Diagram Showing Three-phase, Four-wire Delta Connected System

1.1.3: Blondell's Theorem and Three Phase Measurement

In 1893 an engineer and mathematician named Andre E. Blondell set forth the first scientific basis for poly phase metering. His theorem states:

- If energy is supplied to any system of conductors through N wires, the total power in the system is given by the algebraic sum of the readings of N Wattmeters so arranged that each of the N wires contains one current coil, the corresponding potential coil being connected between that wire and some common point. If this common point is on one of the N wires, the measurement may be made by the use of N-1 Wattmeters.

The theorem may be stated more simply, in modern language:

- In a system of N conductors, N-1 meter elements will measure the power or energy taken provided that all the potential coils have a common tie to the conductor in which there is no current coil.
- Three-phase power measurement is accomplished by measuring the three individual phases and adding them together to obtain the total three phase value. In older analog meters, this measurement was accomplished using up to three separate elements. Each element combined the single-phase voltage and current to produce a torque on the meter disk. All three elements were arranged around the disk so that the disk was subjected to the combined torque of the three elements. As a result the disk would turn at a higher speed and register power supplied by each of the three wires.
- According to Blondell's Theorem, it was possible to reduce the number of elements under certain conditions. For example, a three-phase, three-wire Delta system could be correctly measured with two elements (two potential coils and two current coils) if the potential coils were connected between the three phases with one phase in common.

  In a three-phase, four-wire Wye system it is necessary to use three elements. Three voltage coils are connected between the three phases and the common neutral conductor. A current coil is required in each of the three phases.

- In modern digital meters, Blondell's Theorem is still applied to obtain proper metering. The difference in modern meters is that the digital meter measures each phase voltage and current and calculates the single-phase power for each phase. The meter then sums the three phase powers to a single three-phase reading.

Some digital meters calculate the individual phase power values one phase at a time. This means the meter samples the voltage and current on one phase and calculates a power value. Then it samples the second phase and calculates the power for the second phase. Finally, it samples the third phase and calculates that phase power. After sampling all three phases, the meter combines the three readings to create the equivalent three-phase power value. Using mathematical averaging techniques, this method can derive a quite accurate measurement of three-phase power.

More advanced meters actually sample all three phases of voltage and current simultaneously and calculate the individual phase and three-phase power values. The advantage of simultaneous sampling is the reduction of error introduced due to the difference in time when the samples were taken.

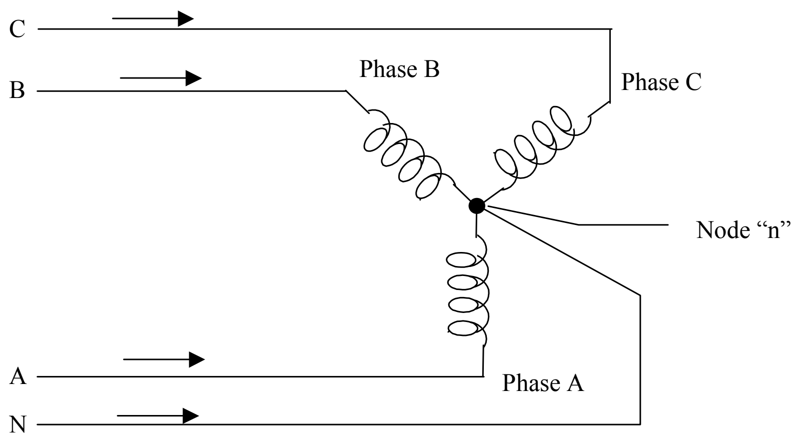


Figure 1.6: Three-Phase Wye Load Illustrating Kirchoff’s Law and Blondell’s Theorem

Blondell's Theorem is a derivation that results from Kirchhoff's Law. Kirchhoff's Law states that the sum of the currents into a node is zero. Another way of stating the same thing is that the current into a node (connection point) must equal the current out of the node. The law can be applied to measuring three-phase loads. Figure 1.6 shows a typical connection of a three-phase load applied to a three-phase, four-wire service. Krichhoff's Laws hold that the sum of currents A, B, C and N must equal zero or that the sum of currents into Node "n" must equal zero.

If we measure the currents in wires A, B and C, we then know the current in wire N by Kirchhoff's Law and it is not necessary to measure it. This fact leads us to the conclusion of Blondell's Theorem that we only need to measure the power in three of the four wires if they are connected by a common node. In the circuit of Figure 1.6 we must measure the power flow in three wires. This will require three voltage coils and three current coils (a three element meter). Similar figures and conclusions could be reached for other circuit configurations involving Delta-connected loads.

1.2: Power, Energy and Demand

- It is quite common to exchange power, energy and demand without differentiating between the three. Because this practice can lead to confusion, the differences between these three measurements will be discussed.

- Power is an instantaneous reading. The power reading provided by a meter is the present flow of Watts. Power is measured immediately just like current. In many digital meters, the power value is actually measured and calculated over a one second interval because it takes some amount of time to calculate the RMS values of voltage and current. But this time interval is kept small to preserve the instantaneous nature of power.

- Energy is always based on some time increment; it is the integration of power over a defined time increment. Energy is an important value because almost all electric bills are based, in part, on the amount of energy used.

- Typically, electrical energy is measured in units of kilowatt-hours (kWh). A kilowatt-hour represents a constant load of one thousand watts (one kilowatt) for one hour. Stated another way, if the power delivered (instantaneous watts) is measured as 1,000 watts and the load was served for a one hour time interval then the load would have absorbed one kilowatt-hour of energy. A different load may have a constant power requirement of 4,000 watts. If the load were served for one hour it would absorb four kWh. If the load were served for 15 minutes it would absorb ¼ of that total or one kWh.

- Figure 1.7 shows a graph of power and the resulting energy that would be transmitted as a result of the illustrated power values. For this illustration, it is assumed that the power level is held constant for each minute when a measurement is taken. Each bar in the graph will represent the power load for the one-minute increment of time. In real life the power value moves almost constantly.

- The data from Figure 1.7 is reproduced in Table 2 to illustrate the calculation of energy. Since the time increment of the measurement is one minute and since we specified that the load is constant over that minute, we can convert the power reading to an equivalent consumed energy reading by multiplying the power reading times 1/60 (converting the time base from minutes to hours).

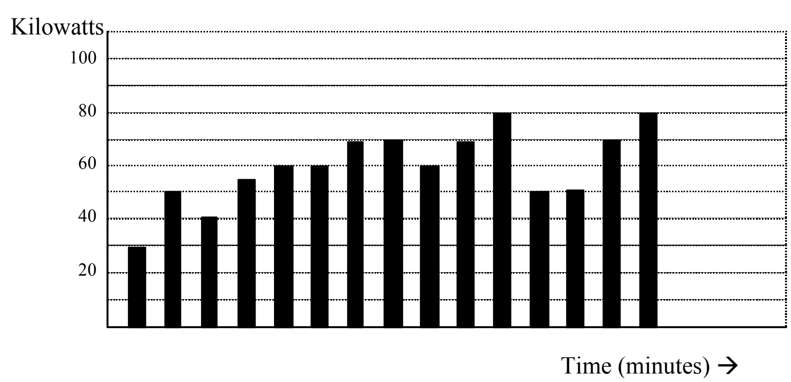


Figure 1.7: Power Use Over Time

Time Interval (Minute)	Power (kW)	Energy (kW)	Accumulated Energy (kWh)
1	30	0.50	0.50
2	50	0.83	1.33
3	40	0.67	2.00
4	55	0.92	2.92
5	60	1.00	3.92
6	60	1.00	4.92
7	70	1.17	6.09
8	70	1.17	7.26
9	60	1.00	8.26
10	70	1.17	9.43
11	80	1.33	10.76
12	50	0.83	12.42
13	50	0.83	12.42
14	70	1.17	13.59
15	80	1.33	14.92

Table 1.2: Power and Energy Relationship Over Time

As in Table 1.2, the accumulated energy for the power load profile of Figure 1.7 is 14.92 kWh.

- Demand is also a time-based value. The demand is the average rate of energy use over time. The actual label for demand is kilowatt-hours/hour but this is normally reduced to kilowatts. This makes it easy to confuse demand with power. But demand is not an instantaneous value. To calculate demand it is necessary to accumulate the energy readings (as illustrated in Figure 1.7) and adjust the energy reading to an hourly value that constitutes the demand.

  In the example, the accumulated energy is 14.92 kWh. But this measurement was made over a 15-minute interval. To convert the reading to a demand value, it must be normalized to a 60-minute interval. If the pattern were repeated for an additional three 15-minute intervals the total energy would be four times the measured value or 59.68 kWh. The same process is applied to calculate the 15-minute demand value. The demand value associated with the example load is 59.68 kWh/hr or 59.68 kWd. Note that the peak instantaneous value of power is 80 kW, significantly more than the demand value.

- Figure 1.8 shows another example of energy and demand. In this case, each bar represents the energy consumed in a 15-minute interval. The energy use in each interval typically falls between 50 and 70 kWh. However, during two intervals the energy rises sharply and peaks at 100 kWh in interval number 7. This peak of usage will result in setting a high demand reading. For each interval shown the demand value would be four times the indicated energy reading. So interval 1 would have an associated demand of 240 kWh/hr. Interval 7 will have a demand value of 400 kWh/hr. In the data shown, this is the peak demand value and would be the number that would set the demand charge on the utility bill.

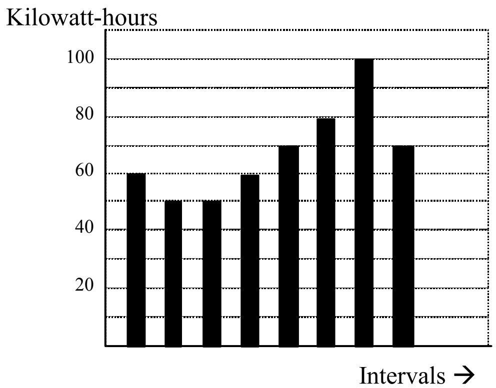


Figure 1.8: Energy Use and Demand

- As can be seen from this example, it is important to recognize the relationships between power, energy and demand in order to control loads effectively or to monitor use correctly.

1.3: Reactive Energy and Power Factor

- The real power and energy measurements discussed in the previous section relate to the quantities that are most used in electrical systems. But it is often not sufficient to only measure real power and energy. Reactive power is a critical component of the total power picture because almost all real-life applications have an impact on reactive power. Reactive power and power factor concepts relate to both load and generation applications. However, this discussion will be limited to analysis of reactive power and power factor as they relate to loads. To simplify the discussion, generation will not be considered.

- Real power (and energy) is the component of power that is the combination of the voltage and the value of corresponding current that is directly in phase with the voltage. However, in actual practice the total current is almost never in phase with the voltage. Since the current is not in phase with the voltage, it is necessary to consider both the in-phase component and the component that is at quadrature (angularly rotated 90^o or perpendicular) to the voltage. Figure 1.9 shows a single-phase voltage and current and breaks the current into its in-phase and quadrature components.

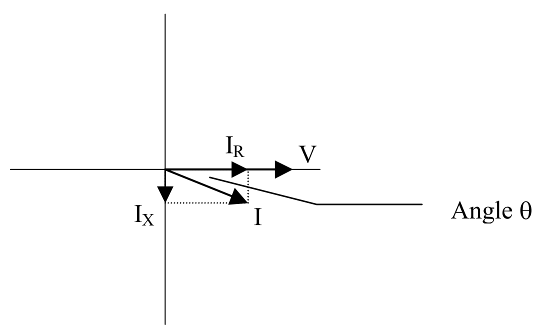


Figure 1.9: Voltage and Complex

- The voltage (V) and the total current (I) can be combined to calculate the apparent power or VA. The voltage and the in-phase current (IR) are combined to produce the real power or watts. The voltage and the quadrature current (IX) are combined to calculate the reactive power.

  The quadrature current may be lagging the voltage (as shown in Figure 1.9) or it may lead the voltage. When the quadrature current lags the voltage the load is requiring both real power (watts) and reactive power (VARs). When the quadrature current leads the voltage the load is requiring real power (watts) but is delivering reactive power (VARs) back into the system; that is VARs are flowing in the opposite direction of the real power flow.

- Reactive power (VARs) is required in all power systems. Any equipment that uses magnetization to operate requires VARs. Usually the magnitude of VARs is relatively low compared to the real power quantities. Utilities have an interest in maintaining VAR requirements at the customer to a low value in order to maximize the return on plant invested to deliver energy. When lines are carrying VARs, they cannot carry as many watts. So keeping the VAR content low allows a line to carry its full capacity of watts. In order to encourage customers to keep VAR requirements low, most utilities impose a penalty if the VAR content of the load rises above a specified value.

  A common method of measuring reactive power requirements is power factor. Power factor can be defined in two different ways. The more common method of calculating power factor is the ratio of the real power to the apparent power. This relationship is expressed in the following formula:

  Total PF = real power / apparent power = watts/VA

  This formula calculates a power factor quantity known as Total Power Factor. It is called Total PF because it is based on the ratios of the power delivered. The delivered power quantities will include the impacts of any existing harmonic content. If the voltage or current includes high levels of harmonic distortion the power values will be affected. By calculating power factor from the power values, the power factor will include the impact of harmonic distortion. In many cases this is the preferred method of calculation because the entire impact of the actual voltage and current are included.

  A second type of power factor is Displacement Power Factor. Displacement PF is based on the angular relationship between the voltage and current. Displacement power factor does not consider the magnitudes of voltage, current or power. It is solely based on the phase angle differences. As a result, it does not include the impact of harmonic distortion. Displacement power factor is calculated using the following equation:

  Displacement PF = $\cos \theta$

  where θ is the angle between the voltage and the current (see Fig. 1.9).

  In applications where the voltage and current are not distorted, the Total Power Factor will equal the Displacement Power Factor. But if harmonic distortion is present, the two power factors will not be equal.

1.4: Harmonic Distortion

- Harmonic distortion is primarily the result of high concentrations of non-linear loads. Devices such as computer power supplies, variable speed drives and fluorescent light ballasts make current demands that do not match the sinusoidal waveform of AC electricity. As a result, the current waveform feeding these loads is periodic but not sinusoidal. Figure 1.10 shows a normal, sinusoidal current waveform. This example has no distortion.

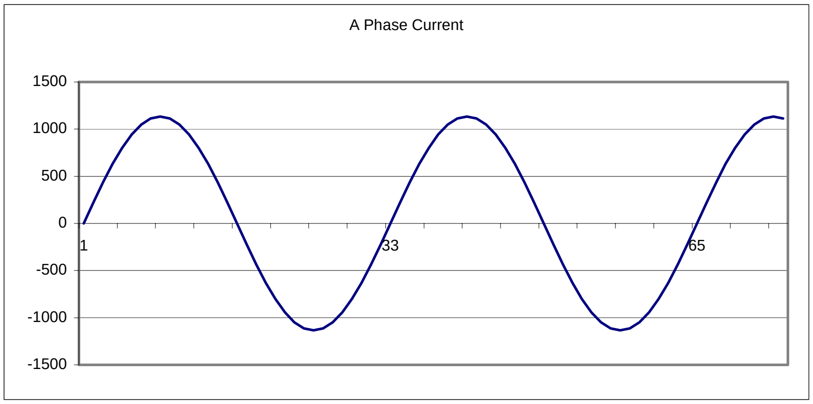


Figure 1.10: Nondistorted Current Waveform

- Figure 1.11 shows a current waveform with a slight amount of harmonic distortion. The waveform is still periodic and is fluctuating at the normal 60 Hz frequency. However, the waveform is not a smooth sinusoidal form as seen in Figure 1.10.

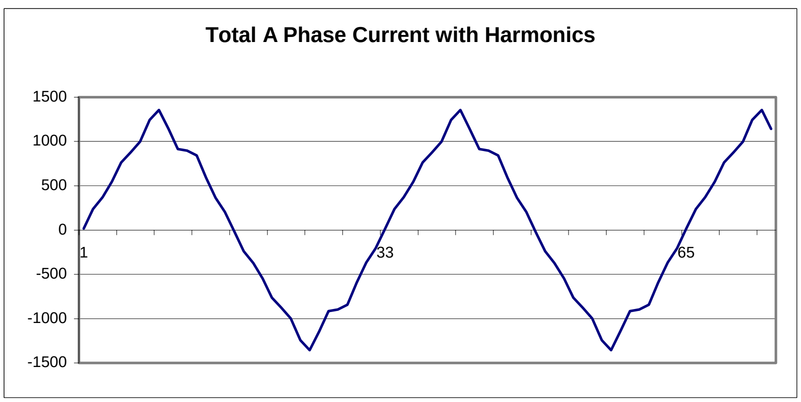


Figure 1.11: Distorted Current Wave

- The distortion observed in Figure 1.11 can be modeled as the sum of several sinusoidal waveforms of frequencies that are multiples of the fundamental 60 Hz frequency. This modeling is performed by mathematically disassembling the distorted waveform into a collection of higher frequency waveforms. These higher frequency waveforms are referred to as harmonics. Figure 1.12 shows the content of the harmonic frequencies that make up the distortion portion of the waveform in Figure 1.11.

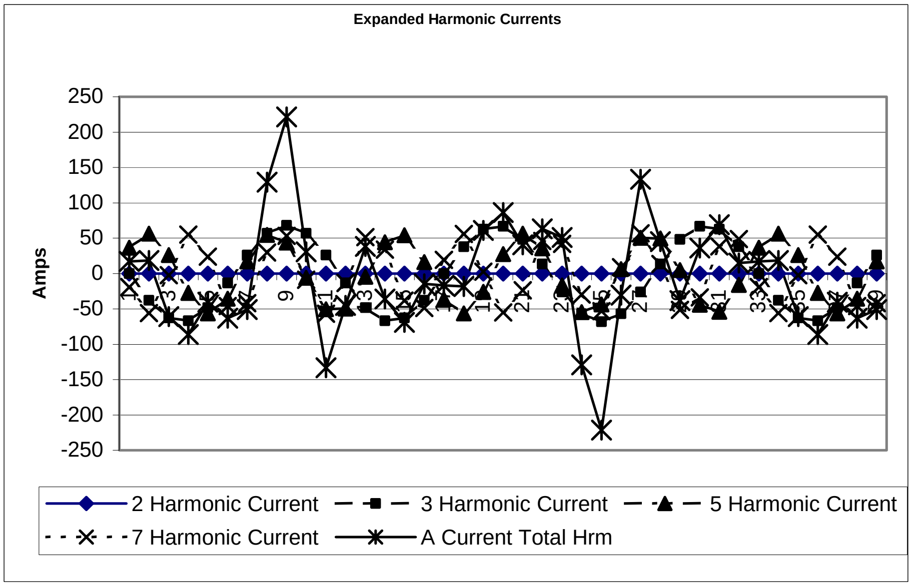


Figure 1.12: Waveforms of the Harmonics

The waveforms shown in Figure 1.12 are not smoothed but do provide an indication of the impact of combining multiple harmonic frequencies together.

When harmonics are present it is important to remember that these quantities are operating at higher frequencies. Therefore, they do not always respond in the same manner as 60 Hz values.

- Inductive and capacitive impedance are present in all power systems. We are accustomed to thinking about these impedances as they perform at 60 Hz. However, these impedances are subject to frequency variation.

$X_L = j\omega L$ and

$X_C = 1/j\omega C$

At 60 Hz, w = 377; but at 300 Hz (5th harmonic) w = 1,885. As frequency changes impedance changes and system impedance characteristics that are normal at 60 Hz may behave entirely differently in presence of higher order harmonic waveforms.

Traditionally, the most common harmonics have been the low order, odd frequencies, such as the 3rd, 5th, 7th, and 9th. However newer, new-linear loads are introducing significant quantities of higher order harmonics.

- Since much voltage monitoring and almost all current monitoring is performed using instrument transformers, the higher order harmonics are often not visible. Instrument transformers are designed to pass 60 Hz quantities with high accuracy. These devices, when designed for accuracy at low frequency, do not pass high frequencies with high accuracy; at frequencies above about 1200 Hz they pass almost no information. So when instrument transformers are used, they effectively filter out higher frequency harmonic distortion making it impossible to see.

- However, when monitors can be connected directly to the measured circuit (such as direct connection to 480 volt bus) the user may often see higher order harmonic distortion. An important rule in any harmonics study is to evaluate the type of equipment and connections before drawing a conclusion. Not being able to see harmonic distortion is not the same as not having harmonic distortion.

- It is common in advanced meters to perform a function commonly referred to as waveform capture. Waveform capture is the ability of a meter to capture a present picture of the voltage or current waveform for viewing and harmonic analysis. Typically a waveform capture will be one or two cycles in duration and can be viewed as the actual waveform, as a spectral view of the harmonic content, or a tabular view showing the magnitude and phase shift of each harmonic value. Data collected with waveform capture is typically not saved to memory. Waveform capture is a real-time data collection event.

  Waveform capture should not be confused with waveform recording that is used to record multiple cycles of all voltage and current waveforms in response to a transient condition.

1.5: Power Quality

- Power quality can mean several different things. The terms "power quality" and "power quality problem" have been applied to all types of conditions. A simple definition of "power quality problem" is any voltage, current or frequency deviation that results in mis-operation or failure of customer equipment or systems. The causes of power quality problems vary widely and may originate in the customer equipment, in an adjacent customer facility or with the utility.

  In his book Power Quality Primer, Barry Kennedy provided information on different types of power quality problems. Some of that information is summarized in Table 1.3.

Cause	Disturbance Type	Source
Impulse Transient	Transient voltage disturbance, sub-cycle duration	Lightning Electrostatic discharge Load switching Capacitor switching
Oscillatory transient with decay	Transient voltage, sub-cycle duration	Line/cable switching Capacitor switching Load switching
Sag/swell	RMS voltage, multiple cycle duration	Remote system faults
Interruptions	RMS voltage, multiple second or longer duration	System protection Circuit breakers Fuses Maintenance
Undervoltage/ Overvoltage	RMS voltage, steady state, multiple second or longer duration	Motor starting Load variations Load dropping
Voltage flicker	RMS voltage, steady state, repetitive condition	Intermittent loads Motor starting Arc furnaces
Harmonic distortion	Steady state current or voltage, long term duration	Non-linear loads System resonance

Table 1.3: Typical Power Quality Problems and Sources

- It is often assumed that power quality problems originate with the utility. While it is true that many power quality problems can originate with the utility system, many problems originate with customer equipment. Customer-caused problems may manifest themselves inside the customer location or they may be transported by the utility system to another adjacent customer. Often, equipment that is sensitive to power quality problems may in fact also be the cause of the problem.

- If a power quality problem is suspected, it is generally wise to consult a power quality professional for assistance in defining the cause and possible solutions to the problem.

Chapter 2
Nexus® 1250/1252 Meter Overview

2.1: Meter Features

Electro Industries' Nexus® 1250/1252 meter is the latest in a generation of meters that combine high-end revenue metering with sophisticated power quality analysis. Features of the Nexus® 1250/1252 meter include:

- EIG Accu-measure™ auto-calibrating metrology
- Advanced monitoring capabilities providing detailed and precise pictures of any metered point within a distribution network.
- Extensive output capability available in conjunction with all metering functions.
- Optional Communicator EXT software that allows you to poll and gather data from multiple Nexus® meters installed at local or remote locations.
- Onboard mass memory enabling the meter to retrieve and store multiple logs, including Power Quality logs (Flicker and EN50160).
- Optional Internal Modem (INP2) or Network Card (INP200), allowing you to connect to a PC via standard phone line or MODBUS/TCP.
- Advanced Power Quality analysis, including Flicker and EN50160 Power Quality Test analysis.

NOTE: Flicker is only available with the Nexus® 1252 meter; EN50160 analysis is only available with the Nexus® 1252 meter equipped with V-Switch™ key 2. See information below.

The Nexus® 1252 meter gives you the ability to purchase the base model that you currently need, and add features as they become necessary, using EIG's patented Virtual Switch™ (V-Switch™) Key Technology, which allows you to perform meter upgrades without removing the meter from its installation. By upgrading your 1252 to V-2, you gain the EN50160 analysis functionality.

Refer to Section 2.2 for instructions on upgrading your meter's V-Switch™ key.

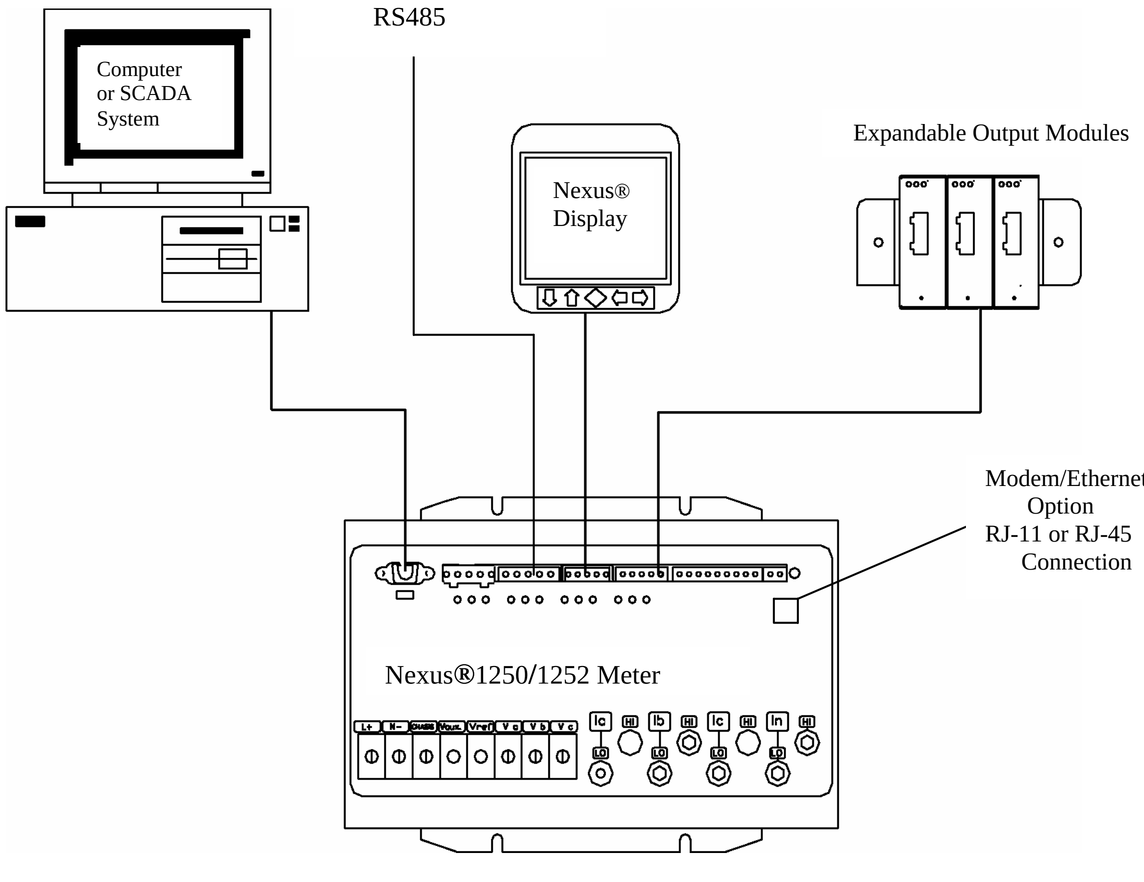


Figure 2.1: The Nexus® Metering System

- The Nexus® 1250/1252 meter's **Revenue Metering** capabilities include:
  - Delivers laboratory-grade 0.04% Watt-hour accuracy in a field-mounted device.
  - Auto-calibrates when there is a temperature change of about 2 degrees centigrade.
  - Exceeds all ANSI C-12 and IEC 687 specifications.
  - Adjusts for transformer and line losses, using user-defined compensation factors.
  - Automatically logs time-of-use for up to eight programmable tariff registers.
  - Counts pulses and aggregates different loads.

- The Nexus® 1250/1252 meter's **Power Quality Monitoring** capabilities include:
  - Records up to 512 samples per cycle on an event.
  - Records sub-cycle transients on voltage or current readings.
  - Measures and records Harmonics to the 255th order (Real Time Harmonics to the 128th order).
  - Offers inputs for neutral-to-ground voltage measurements.
  - Synchronizes with IRIG-B clock signal.
  - Offers Line Sync capability to power line.
  - Measures Flicker (1252 only).
  - Offers EN50160 logging and analysis (1252 V-2 only).

- Nexus® 1250/1252 Meter **Memory, Communication, and Control** capabilities include:
  - Up to 4 Meg NVRAM.
  - 4 High Speed Communication Ports.
  - Multiple Protocols (see section below on DNP V3.00).
  - 90msec High Speed Updates for Control.

2.2: Upgrading the Meter's V-Switch™ Key

The Nexus® 1252 meter's base configuration is V-Switch™ key 1 (V-1). To upgrade your Nexus® 1252 meter to a higher V-Switch™ key, follow these steps.

1. Obtain a V-Switch™ Upgrade Key by contacting EIG's inside sales staff at sales@electroind.com or by calling (516) 334-0870 (USA). You will be asked for the following information:

    a. Serial Number or Numbers of the meters you are upgrading.
    b. Desired V-Switch™ Key Upgrade.
    c. Credit Card or Purchase Order Number.

2. EIG will issue you the V-Switch™ Upgrade Key. To enable the V-Switch™ key**:**

    a. Install Communicator EXT 3.0 on your computer, or open the already installed software application.
    b. Power up your Nexus® meter.
    c. Connect to the Nexus® meter through Communicator EXT (see Chapter 3 of the *Communicator EXT User Manual* for detailed instructions).
    d. Click **Tools>Change V-Switch**™ from the Title Bar. A screen opens, requesting the encrypted key (V-Switch™ Upgrade Key).
    e. Enter the V-Switch™ Upgrade Key provided by EIG.
    f. Click the **OK** button. The V-Switch™ key is enabled and the meter is reset.

NOTE: The Nexus® 1250 meter does not have a V-Switch™ key upgrade.

2.3: DNP V3.00 Level 1 and Level 2

The Nexus® 1250 meter supports DNP V300 Level 1; the Nexus® 1252 meter supports DNP V3.00 Level 2.

- DNP Level 2 Features include:
  - Up to 136 measurements (64 Binary Inputs, 8 Binary Counters, 64 Analog Inputs) can be mapped to DNP Static Points (over 3000) in the customizable DNP Point Map.
  - Up to 16 Relays and 8 Resets can be controlled through DNP Level 2.
  - Report-by-Exception Processing (DNP Events). Deadbands can be set on a per-point basis.
  - Freeze Commands: Freeze, Freeze/No-Ack, Freeze with Time, Freeze with Time/No-Ack.
  - Freeze with Time Commands enable the Nexus® meter to have internal time-driven Frozen and Frozen Event data. When the Nexus® meter receives the Time and Interval, the data will be created.

For complete details, download the appropriate DNP User Manual from our website: www.electroind.com.

2.4: Flicker, EN50160, IEC 61000-4-30 Analysis

The Nexus® 1252 meter with V-1 (base configuration) provides Flicker Evaluation in Instantaneous, Short Term and Long Term Forms. The Nexus® 1252 meter with V-Switch™ key 2 provides EN50160 Power Quality Compliance. See Chapter 12 for a detailed explanation of the Flicker and EN50160 functions.

2.5: Communication Options

- The Internal Modem Option **(INP2**) for the Nexus® 1250/1252 meter provides a direct connection to a standard telephone line. See Chapters 5 and 10 for details on the INP2 option.

- The 10/100BaseT Ethernet Option (**INP200**) 100BastT Ethernet communication.

2.6: Measurements and Calculations

The **Nexus® 1250/1252 meter** measures many different power parameters. Following is a list of the formulas used to conduct calculations with samples for Wye and Delta services.

Samples for **Wye**: v_{an}, v_{bn}, v_{cn}, i_a, i_b, i_c, i_n

Samples for **Delta**: v_{ab}, v_{bc}, v_{ca}, i_a, i_b, i_c

- **Root Mean Square (RMS) of Phase to Neutral Voltages:** n = number of samples

For **Wye**: x = an, bn, cn

$$V_{RMS_x} = \sqrt{\frac{\sum_{t=1}^{n} v_{x(t)}^2}{n}}$$

- **Root Mean Square (RMS) of Currents:** n = number of samples

For **Wye**: x=a, b, c, n
For **Delta**: x = a, b, c

$$I_{RMS_x} = \sqrt{\frac{\sum_{t=1}^{n} i_{x(t)}^2}{n}}$$

- **Root Mean Square (RMS) of Phase to Phase Voltages:** n = number of samples

For **Wye**: x, y= an, bn or bn, cn or cn, an

$$V_{RMS_{xy}} = \sqrt{\frac{\sum_{t=1}^{n} (v_{x(t)} - v_{y(t)})^2}{n}}$$

For **Delta**: xy = ab, bc, ca

$$V_{RMS_{xy}} = \sqrt{\frac{\sum_{t=1}^{n} v_{xy(t)}^2}{n}}$$

- **Power (Watts) per phase:**

For **Wye**: x = a, b, c

$$W_X = \frac{\sum_{t=1}^{n} v_{xn(t)} \bullet i_{x(t)}}{n}$$

- **Apparent Power (VA) per phase:**

For **Wye**: x = a, b, c

$$VA_x = V_{RMS_{XN}} \bullet I_{RMS_X}$$

- **Reactive Power (VAR) per phase:**

For **Wye**: x = a, b, c

$$VAR_x = \sqrt{VA_x^2 - Watt_x^2}$$

- **Power (Watts) Total:**

For **Wye**:

$$W_T = W_a + W_b + W_c$$

For **Delta**:

$$W_T = \frac{\sum_{t=1}^{n} (v_{AB_{(t)}} \bullet i_{A_{(t)}} - v_{BC_{(t)}} \bullet i_{C_{(t)}})}{n}$$

- **Reactive Power (VAR) Total:**

  For **Wye**:

$$VAR_T = VAR_A + VAR_B + VAR_C$$

For **Delta**:

$$VAR_T \sqrt{(V_{RMS_{AB}} \bullet I_{RMS_A})^2 - \left[\frac{\sum_{t=1}^{n} v_{AB(t)} \bullet i_{A(t)}}{n}\right]^2}$$

$$+$$

$$\sqrt{(V_{RMS_{BC}} \bullet I_{RMS_C})^2 - \left[\frac{\sum_{t=1}^{n} v_{BC(t)} \bullet i_{C(t)}}{n}\right]^2}$$

- **Apparent Power (VA) Total:**

  For **Wye**:

$$VA_T = VA_A + VA_B + VA_C$$

For **Delta**:

$$VA_T = \sqrt{W_T^2 + VAR_T^2}$$

- **Power Factor (PF):**

  For **Wye**: x = A, B, C, T

  For **Delta**: x = T

$$PF_x = \frac{Watt_x}{VA_x}$$

- **Phase Angles:**

$$\angle = \cos^{-1}(PF)$$

- **% Total Harmonic Distortion (%THD):**

  For **Wye**: x = V_{AN}, V_{BN}, V_{CN}, I_A, I_B, I_C

  For **Delta**: x = I_A, I_B, I_C, V_{AB}, V_{BC}, V_{CA}

$$THD = \frac{\sqrt{\sum_{h=2}^{127}(RMS_{x_h})^2}}{RMS_{x_1}}$$

- **K Factor:** x = I_A, I_B, I_C

$$KFactor = \frac{\sum_{h=1}^{127}(h \bullet RMS_{x_h})^2}{\sqrt{\sum_{h=1}^{127}(RMS_{x_h})^2}}$$

- **Watt hour (Wh):**

$$Wh = \sum_{t=1}^{n}\frac{W_{T(t)}}{3600_{\sec/hr}}$$

- **VAR hour (VARh):**

$$VARh = \sum_{t=1}^{n}\frac{VAR_{T(t)}}{3600_{\sec/hr}}$$

2.7: Demand Integrators

Power utilities take into account both **energy consumption** and **peak demand** when billing customers. Peak demand, expressed in kilowatts (kW), is the highest level of demand recorded during a set period of time, called the interval. The Nexus® 1250/1252 meter supports the following most popular conventions for averaging demand and peak demand: **Thermal Demand**, **Block Window Demand**, **Rolling Window Demand** and **Predictive Window Demand**. You can program and access all conventions concurrently with the Communicator EXT software (see the *Communicator EXT User Manual*).

- **Thermal Demand**: Traditional analog watt-hour (Wh) meters use heat-sensitive elements to measure temperature rises produced by an increase in current flowing through the meter. A pointer moves in proportion to the temperature change, providing a record of demand. The pointer remains at peak level until a subsequent increase in demand moves it again, or until it is manually reset. The Nexus® 1250/1252 meter mimics traditional meters to provide Thermal Demand readings.

  Each second, as a new power level is computed, a recurrence relation formula is applied. This formula recomputes the thermal demand by averaging a small portion of the new power value with a large portion of the previous thermal demand value. The proportioning of new to previous is programmable, set by an averaging interval. The averaging interval represents a 90% change in thermal demand to a step change in power.

- **Block (Fixed) Window Demand**: This convention records the average (arithmetic mean) demand for consecutive time intervals (usually 15 minutes).

  Example: A typical setting of 15 minutes produces an average value every 15 minutes (at 12:00, 12:15. 12:30. etc.) for power reading over the previous fifteen minute interval (11:45-12:00, 12:00-12:15, 12:15-12:30, etc.).

- **Rolling (Sliding) Window Demand**: Rolling demand functions like multiple, overlapping Block demand. You define the subintervals at which an average of demand is calculated. An example of Rolling demand would be

  Example: A 15-minute Demand block using 5-minute subintervals, thus providing a new demand reading every 5 minutes, based on the last 15 minutes

- **Predictive Window Demand**: Predictive Window Demand enables you to forecast average demand for future time intervals. The Nexus® 1250/1252 meter uses the delta rate of change of a Rolling Window Demand interval to predict average demand for an approaching time period. You can set a relay or alarm to signal when the Predictive Window reaches a specific level, thereby avoiding unacceptable demand levels. The Nexus® 1250/1252 meter calculates Predictive Window Demand using the formula shown on the next page.

Example: Using the previous settings of 3 five-minute intervals and a new setting of 120% prediction factor, the working of the Predictive Window Demand could be described as follows:
At 12:10, we have the average of the subintervals from 11:55-12:00, 12:00-12:05 and 12:05-12:10. In five minutes (12:15), we will have an average of the subintervals 12:00-12:05 and 12:05-12:10 (which we know) and 12:10-12:15 (which we do not yet know). As a guess , we will use the last subinterval (12:05-12:10) as an approximation for the next subinterval (12:10-12:15). As a further refinement, we will assume that the next subinterval might have a higher average (120%) than the last subinterval. As we progress into the subinterval, (for example, up to 12:11), the Predictive Window Demand will be the average of the first two subintervals (12:00-12:05, 12:05-12:10), the actual values of the current subinterval (12:10-12:11) and the predistion for the remainder of the subinterval, 4/5 of the 120% of the 12:05-12:10 subinterval.

# of Subintervals = n
Subinterval Length = Len
Partial Subinterval Length = Cnt

Sub_n	...	Sub_1	Sub_0	Partial	Predict
Len		Len	Len	Cnt	Len

$$Sub = \frac{\sum_{i=0}^{Len-1} Value_i}{Len}$$

$$Partial = \frac{\sum_{i=0}^{Cnt-1} Value_i}{Cnt}$$

$$\left[Partial + \frac{\sum_{i=0}^{n-2} Value_i}{n} \right] \times \left[1 - \left[\left[\frac{Len - Cnt}{Len} \right] \times Pct \right] \right]$$

$$+ \left[\frac{\sum_{i=0}^{n-2} Sub_i}{n-1} + \frac{Sub_0 - Sub_{n-1}}{2x(n-1)} \right] \times \left[\left[\frac{Len - Cnt}{Len} \right] \times Pct \right]$$

2.8: Nexus® External Output Modules (Optional)

The following multiple analog or digital Output modules mount externally to the Nexus® meter. The meter supports up to four Output modules using internal power. Use the additional power supply, **EIG PSIO**, to extend Output capability. See Section 3.4 for mounting diagrams.

See Chapter 9 for details on installation and usage of the Nexus® External Output Modules.

- **Analog Transducer Signal Outputs** (Up to two modules can be used)
  - **1mAON4**: 4 Analog Outputs, self powered, scalable, bidirectional.
  - **1mAON8**: 8 Analog Outputs, self powered, scalable, bidirectional.
  - **20mAON4**: 4 Analog Outputs, self powered, scalable.
  - **20mAON8**: 8 Analog Outputs, self powered, scalable.

- **Digital Dry Contact Relay Outputs** (Multiple modules can be used.)
  - **4RO1**: 4 Relay Outputs 10 Amps, 125V AC, 30V DC, Form C.

- **Digital Solid State Pulse Outputs** (Multiple modules can be used.)
  - **4PO1**: 4 Solid State Pulse Outputs, Form A KYZ pulses.

- **Other Output Accessories**
  - **PSIO**: Additional power supply for up to six Output modules. This unit is necessary if you are connecting more than four Output modules to a Nexus® 1250/1252 meter.
  - **MBIO**: Bracket for surface-mounting Output modules to any enclosure.

2.9: Meter Specifications

- UL Measurement Category - CategoryIII
  Rated Altitude - 2,000 Meters Maximum

Specification	**Nexus® 1250/1252 Meter**
Control Power Requirement	Option D: 24VDC (-20%) - 48VDC (+20%)
	Option D2: 120V AC/DC (-20%) - 230VAC (+20%)
	Connection Screws' Torque: (6 to 9) in-lb. max. or (0.68 to 1) Nm max.
Input Voltage Range	150V Phase to Neutral (Standard; for use with PTs)
	300V Phase to Neutral (Option -G)
Input Current Range	10A Maximum (Programmable to any CT Ratio)
Input Withstanding Capabilities	Current: Continuous 200% Rated
	Current: surge 10x maximum input for 3 seconds
	Surge Withstanding per IEEE C37.90.1
Burden	Voltage: 0.05VA @120V rms
	Current: 0.002VA @ 120V rms
I/O Isolation	2500VDC, 60Hz
Sensing Method	RMS
Update Time	90msec
Frequency Range	Fundamental 20-65Hz
	Up to 255th Harmonic Measuring Capability
Dimensions (HxWxL)	3.4 x 7.3 x 10.5 inches / 8.6 x 18.5 x 26.6 centimeters
Maximum Power Consumption	40 Watts (with optional modules and display)
Nominal Power Consumption	Approximately 18VA/12W @120V(without optional modules and display)
Operating Temperature	-40^{o} C to +70^{o} C / -40^{o} F to +158^{o} F
Auxiliary Output Power Voltage	15-20 VDC at 50-200mA
Maximum Auxiliary Power Current	0.8A (short protected)
Maximum Power Supply Range	(100-250)VAC
UL Listing	1244* * Not evaluated for accuracy, reliability, or capability to perform intended function.
Flicker	Evaluation per IEC61000-4-15
EN50160 PQ Analysis**	Per IEC61000-4-30

**EN50160 PQ analysis is only available for a Nexus® 1252 meter with V-Switch™ key 2.

2.10: Nexus® P40N, P41N, P43N LED External Display Specifications

Specification	Nexus® P40N, P41N, P43N LED External Display
Maximum Input Voltage	30V DC
Minimum Input Voltage	7V DC
Maximum Power Consumption	8 Watts
Nominal Power Consumption	Approximately 6 Watts
Operating Temperature Range	-40°C to + 80°C / -40°F to +176°F
Overall Dimensions (HxWxL)	2.2 x 4.4 x 4.4 in / 5.9 x 11.1 x 11.1 cm

2.11: Nexus® P60N Touch Screen Display Specifications

Specification	Nexus® P60N Touch Screen Display
Maximum Input Voltage	30V DC
Minimum Input Voltage	10V DC
Maximum Power Consumption	5 Watts
Nominal Power Consumption	Approximately 4.5 Watts
Operating Temperature Range	0°C to + 50°C / +32°F to +122°F
Overall Dimensions (HxWxL)	1.6 x 5.4 x 8.0 in / 4.0 x 13.7 x 20.3 cm

Chapter 3
Hardware Installation

3.1: Mounting the Nexus® Meter

- The Nexus® 1250/1252 meter is designed to mount against any firm, flat surface. Use a #10 screw in each of the four slots on the flange to ensure that the unit is installed securely. For safety reasons, mount the meter in an enclosed and protected environment, such as in a switchgear cabinet. Install a switch or circuit breaker nearby; label it clearly as the meter's disconnecting mechanism.

- Maintain the following conditions:
  - Operating Temperature: -40°C to +80°C / -40°F to +176°F
  - Storage Temperature: -45°C to +85°C / -49°F to +185°F
  - Relative Humidity: 5 to 95% non-condensing

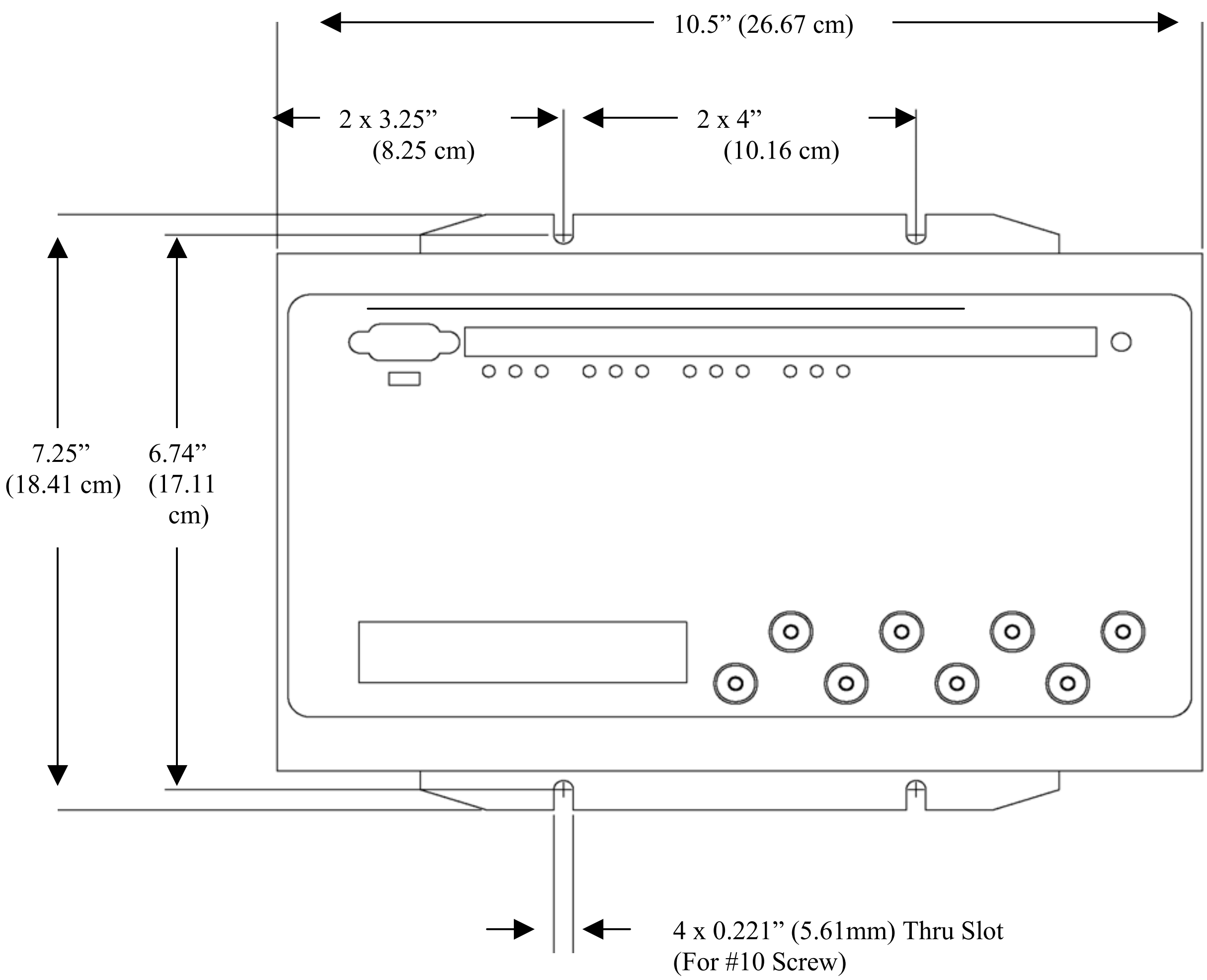


Figure 3.1: Nexus® 1250/1252 Meter Mounting Diagram, Top View

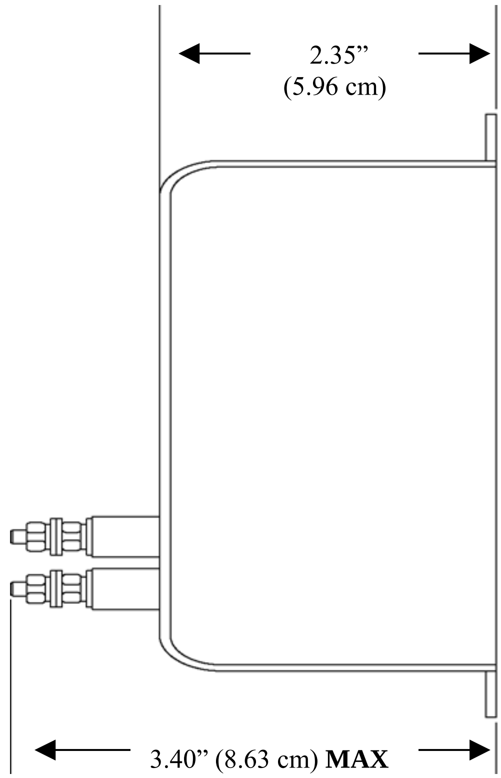


Figure 3.2: Nexus® 1250/1252 Meter Mounting Diagram, Side View

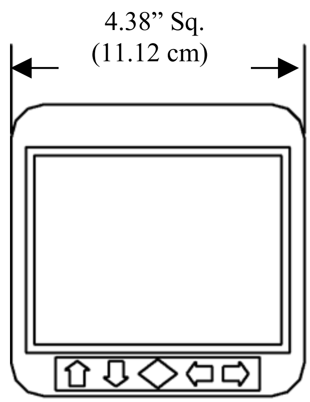
3.2: Mounting the Nexus® LED External Displays

- The Nexus® 1250/1252 meter LED Displays: Models # **P40N**, **P41N** and **P43N**, mount using a standard ANSI C39.1 drill plan.

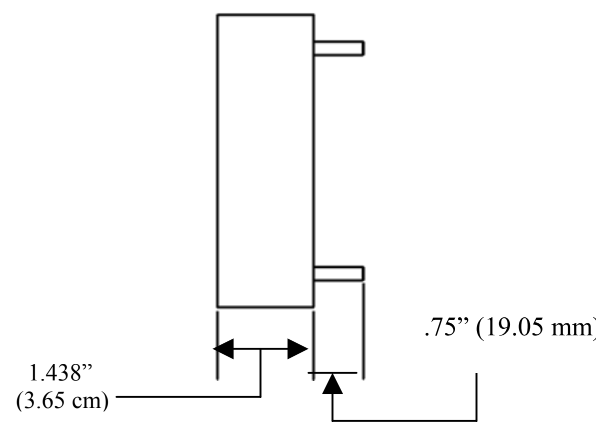
- Secure the four mounting studs to the back of the panel with the supplied nuts.

- Six feet of RS-485 communication/power cable harness is supplied. Allow for at least a 1.25-inch (3.17cm) diameter hole in the back for the cable harness. See Chapter 5 for communication and power supply details.

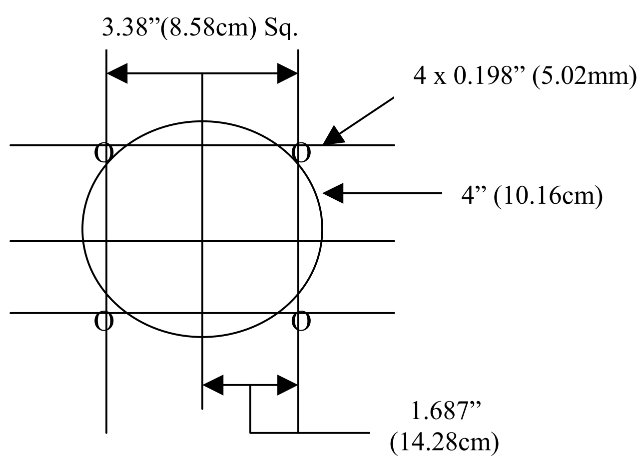
    - The cable harness brings power to the display from the Nexus® 1250/1252 meter, which supplies 15–20V DC. The P40N (or P41N or P43N) can draw up to 500mA in display test mode.



Nexus® P40N Display, Front View



Nexus® P40N Display, Side View



ANSI C39.1 Drill Plan

Figure 3.3: Nexus® P40N LED External Display Mounting Diagrams

3.3: Mounting the Nexus® P60N Touch Screen External Display

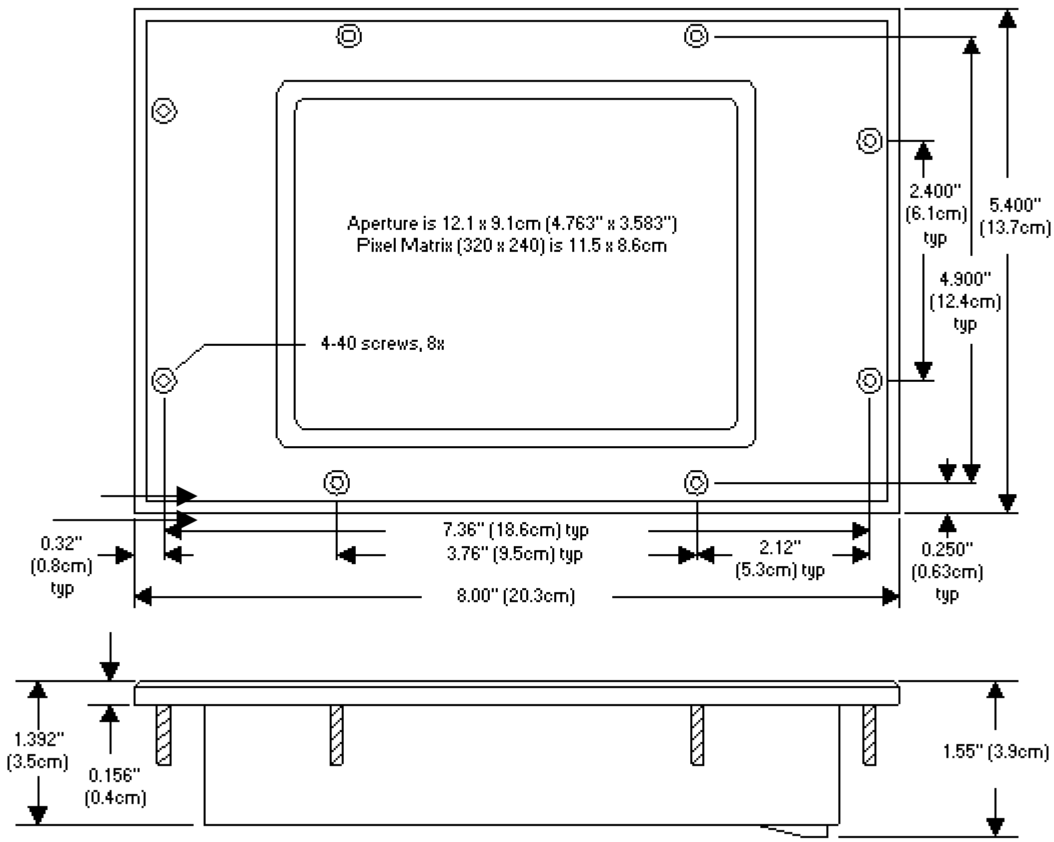


Figure 3.4: Nexus® P60N Touch Screen Display Mounting Diagram

- The Nexus® P60N Touch Screen Display mounts easily, using the diagrams above and on the next page. A bezel and a gasket are included with the P60N. Since the P60N employs an LCD display, the viewing angle must be considered when mounting. Install the P60N at a height and angle that make it easy for the operator to see and access the screen.

- For optimum performance, maintain the following conditions where the Touch Screen Display is mounted:

  - **Operating Temperature**: 0°C to +50°C / +32°F to +122°F
  - **Storage Temperature**: -20°C to +70°C / -36°F to +158°F
  - **Relative Humidity**: 25 to 65% non-condensing

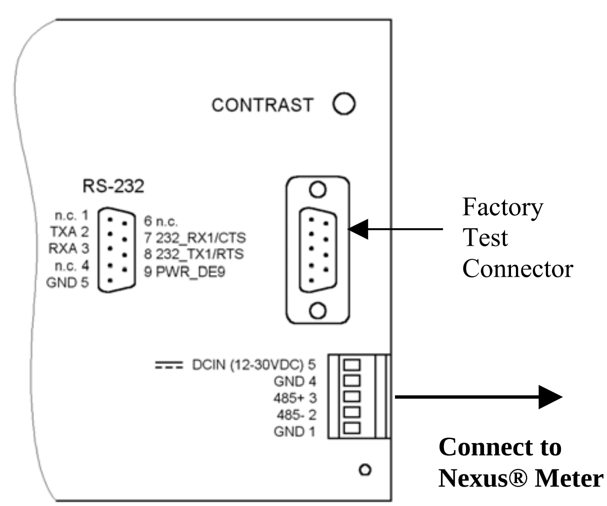


Figure 3.5: Nexus® P60N Display's Back Detail

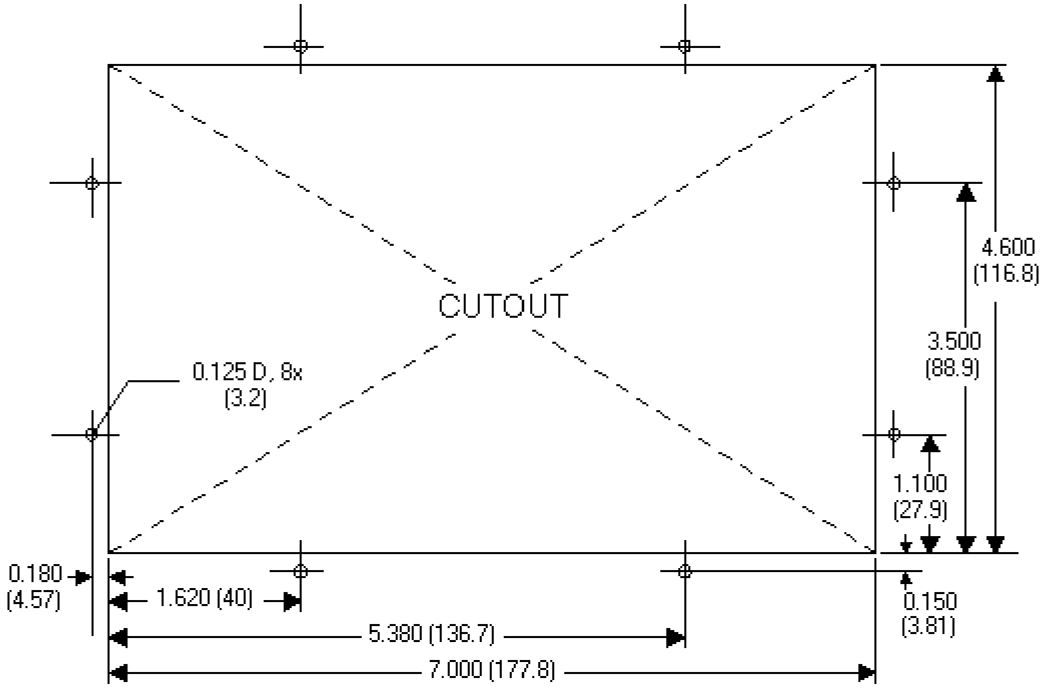


Figure 3.6: Cutout for Nexus® P60N Touch Screen Display

- To bezel mount the P60N, cut an opening in the mounting panel. Follow cutout dimensions shown above.
- Carefully "drop in" the P60N with bezel and gasket attached.
- Fasten the unit securely with the four 6-32 hex nuts supplied.

3.4: Mounting the Nexus® External Output Modules

- Secure the mounting brackets to the Output module using the screws supplied (#440 pan-head screws). Next, secure the brackets to a flat surface using a #8 screw with a lock washer.
- If multiple Output modules are connected together, as shown in Figure 3.7, secure a mounting bracket to both ends of the group. One Nexus® 1250/1252 meter will supply power for up to four Output modules. To connect more than four Output modules, use an additional power supply, such as the EIG PSIO. Connect multiple Output modules using the RS485 side ports. See Chapter 9 for additional information.
- Six feet of RS485 cable harness is supplied. The cable harness brings power to the display from the Nexus® meter, which supplies 15–20V DC at 50–200mA. See Chapter 5 for power supply and communication details.

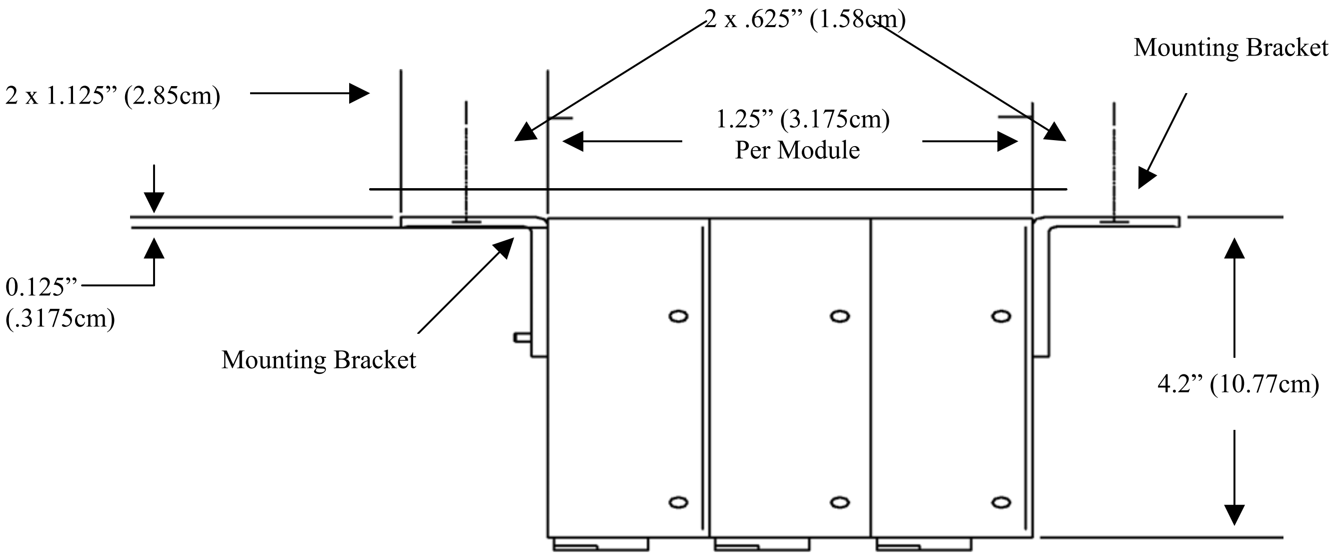


Figure 3.7: Nexus® Output Modules Mounting Diagram, Overhead View

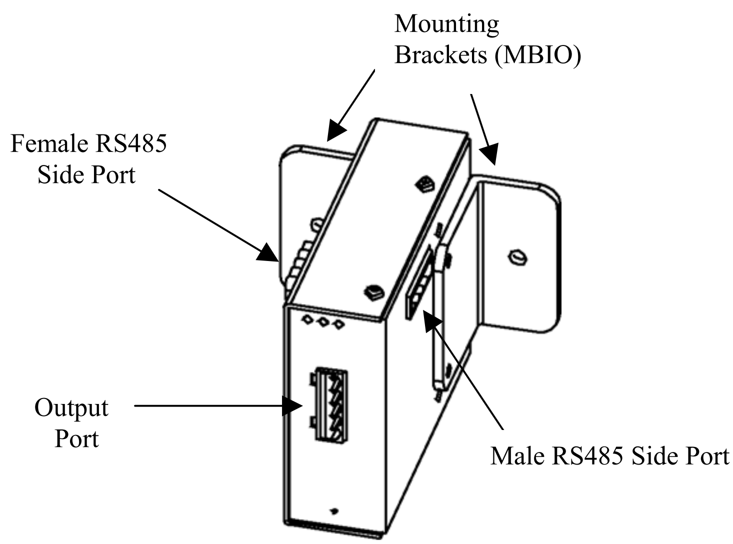


Figure 3.8: Nexus® Output Module Communication Ports

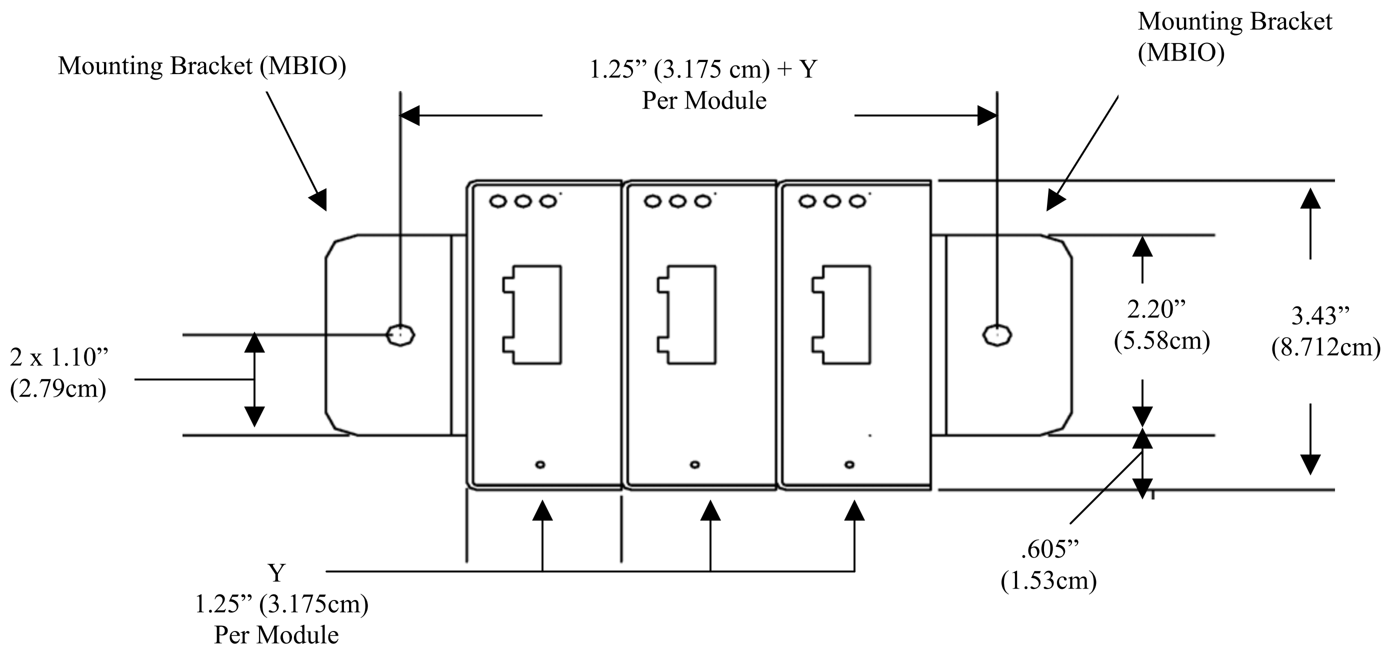


Figure 3.9: Nexus® Output Modules Mounting Diagram, Front View

Chapter 4
Electrical Installation

4.1: Considerations When Installing Meters

- Installation of the Nexus® 1250/1252 meter must be performed only by qualified personnel who follow standard safety precautions during all procedures. Those personnel should have appropriate training and experience with high voltage devices. Appropriate safety gloves, safety glasses and protective clothing are recommended.
- During normal operation of the Nexus® meter, dangerous voltages flow through many parts of the unit, including: Terminals and any connected CTs (Current Transformers) and PTs (Potential Transformers), all Output Modules and their circuits. All Primary and Secondary circuits can, at times, produce lethal voltages and currents. Avoid contact with any current-carrying surfaces.
- Do not use the meter or any Output device for primary protection or in an energy-limiting capacity. The meter can only be used as secondary protection. Do not use the meter for applications where failure of the meter may cause harm or death. Do not use the meter for any application where there may be a risk of fire.
- All meter terminals should be inaccessible after installation.
- Do not apply more than the maximum voltage the meter or any attached device can withstand. Refer to meter and/or device labels and to the Specifications for all devices before applying voltages. Do not HIPOT/Dielectric test any Outputs, Inputs or Communications terminals.
- EIG recommends the use of Shorting Blocks and Fuses for voltage leads and power supply to prevent hazardous voltage conditions or damage to CTs, if the meter needs to be removed from service. **CT grounding is optional.**

(Continued on next page)

- **To comply with UL standards,** the meter case must be connected to a reliable protective earth available within the installation area. For this connection use minimum #14 AWG wire crimped to a ring terminal(3) with a dedicated tool. Fasten the ring terminal(3) to the lower left slot of the meter case with minimum #6 metal screw(1) and star washer(2), as is shown in Figure 4.1.
- The UL Classification of the meter is Measurement Category III, Pollution Degree 2.

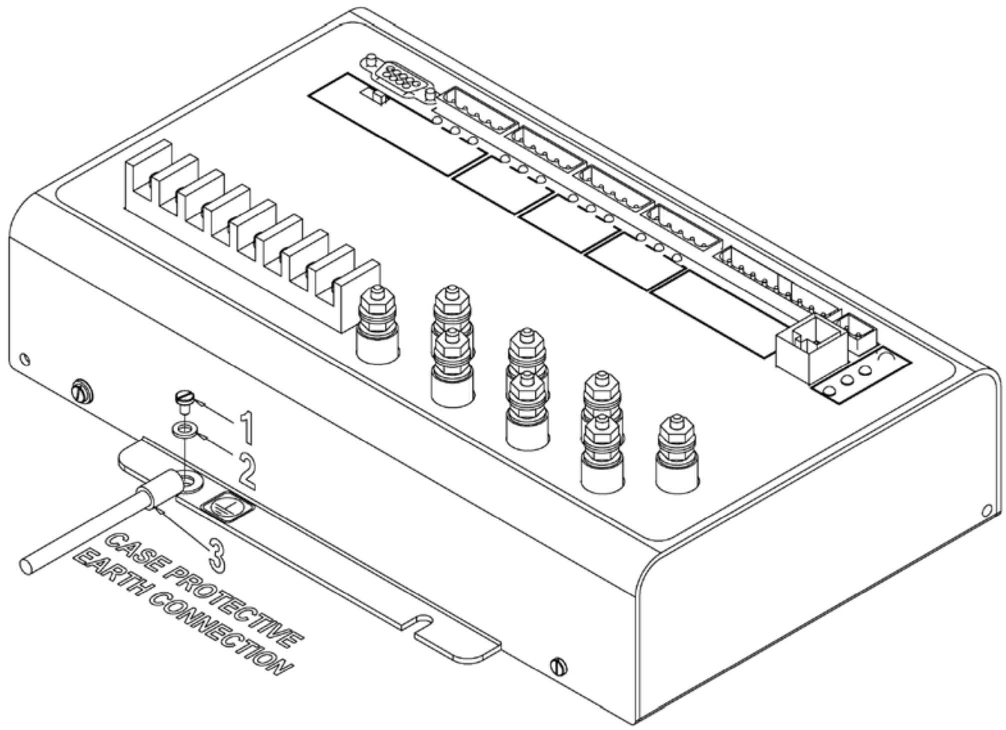


Figure 4.1: Meter Case's Earth Ground Connection

NOTE: IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, THE PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.

NOTE: THERE IS NO REQUIRED PREVENTIVE MAINTENANCE OR INSPECTION NECESSARY FOR SAFETY. HOWEVER, ANY REPAIR OR MAINTENANCE SHOULD BE PERFORMED BY THE FACTORY.

DISCONNECT DEVICE: The following part is considered the equipment disconnect device.
A SWITCH OR CIRCUIT-BREAKER SHALL BE INCLUDED IN THE END-USE EQUIPMENT OR BUILDING INSTALLATION. THE SWITCH SHALL BE IN CLOSE PROXIMITY TO THE EQUIPMENT AND WITHIN EASY REACH OF THE OPERATOR. THE SWITCH SHALL BE MARKED AS THE DISCONNECTING DEVICE FOR THE EQUIPMENT.

4.2: Wiring the Monitored Inputs and Voltages

- Select a wiring diagram from Section 4.8 that best suits your application. Wire the Nexus® 1250/1252 meter exactly as shown. For proper operation, the voltage connection must be maintained and must correspond to the correct terminal. Program the CT and PT Ratios in the Device Profile section of the Communicator EXT software; see the *Communicator EXT User Manual* for details.

  The cable required to terminate the voltage sense circuit should have an insulation rating greater than 600V AC and a current rating greater than 0.1 Amp.

  Use a minimum of 14 AWG wire for all phase voltage and current connections.

  The maximum installation torque for both the current input terminals and the voltage connections is 1 Newton-Meter.

4.3: Fusing the Voltage Connections

- For accuracy of the readings and for protection, EIG requires using 0.25-Amp rated fuses on all voltage inputs as shown in the wiring diagrams (see Section 4.8).

  The Nexus® 1250/1252 meter can handle a maximum voltage of 150V phase to neutral and 300V phase to phase. Potential Transformers (PTs) are required for higher voltages with the standard rating. With Option -G, the direct voltage input is extended to 300V phase to neutral and 600V phase to phase.

4.4: Wiring the Monitored Inputs - VRef

- The Voltage Reference connection references the monitor to ground or neutral.

4.5: Wiring the Monitored Inputs - VAux

- The Voltage Auxiliary connection is an auxiliary voltage input that can be used for any desired purpose, such as monitoring neutral to ground voltage or monitoring two different lines on a switch.

4.6: Wiring the Monitored Inputs - Currents

- Install the cables for the current at 600V AC minimum insulation. The cable connector should be rated at 10 Amps or greater and have a cross-sectional area of 14 AWG.

- Mount the current transformers (CTs) as close as possible to the meter. The following table illustrates the maximum recommended distances for various CT sizes, assuming the connection is via 14 AWG cable.

EIG Recommendations

CT Size (VA)	Maximum distance from CT to Nexus® 1250/1252 Meter (Feet)
2.5	10
5	15
7.5	30
10	40
15	60
30	120

> **WARNING! DO NOT leave the secondary of the CT open when primary current is flowing.** This may cause high voltage, which will overheat the CT. If the CT is not connected, provide a shorting block on the secondary of the CT.

- It is important to maintain the polarity of the CT circuit when connecting to the Nexus® 1250/1252 meter. If the polarity is reversed, the meter will not provide accurate readings. CT polarities are dependent upon correct connection of CT leads and the direction CTs are facing when clamped around the conductors. Although shorting blocks are not required for proper meter operation, EIG recommends using shorting blocks to allow removal of the Nexus® 1250/1252 meter from an energized circuit, if necessary.

4.7: Isolating a CT Connection Reversal

- For a Wye System, you may either:
  - Check the current phase angle reading on the meter's External Display (see Chapter 6). If it is negative, reverse the CTs.
  - Go to the Phasors screen of the Communicator EXT software (see Chapter 3 of the *Communicator EXT User Manual* for instructions). Note the phase relationship between the current and voltage: they should be in phase with each other.

- For a Delta System:
  Go to the Phasors screen of the Communicator EXT software program (see Chapter 3 of the *Communicator EXT User Manual* for instructions). The current should be 30 degrees off the phase-to-phase voltage.

4.8: Instrument Power Connections

- The Nexus® 1250/1252 meter requires a separate power source.

  • To use AC power:
    1. Connect the line supply wire to the L+ terminal
    2. Connect the neutral supply wire to the N- terminal on the meter.

  • To use DC power:
    1. Connect the positive supply wire to the L+ terminal.
    2. Connect the negative (ground) supply wire to the N- terminal on the meter.

Power supply options and corresponding suffixes are listed in the table shown on the next page.

Control Power	Option Suffix
18-60 Volts DC	D
90-276 Volts AC/DC	D2

- Do not ground the unit through the negative of the DC supply. **Separate grounding is required.**

- Externally fuse the power supply with a 5 Amp @250V rated slow blow fuse. EIG recommends that you fuse **both** the L+ and N- connections for increased safety, but if you are fusing only one connection, fuse the L+ connection.

- Use 14 Gauge supply wire for the power supply and ground connections.

NOTE ON CORRECT METER FUNCTIONING:

The Nexus® 1250/1252 meter has a Heartbeat LED, located on the top, right side of the meter face. When the meter is functioning correctly, the red LED pulse toggles on and off (blinks) 5 times per second. If the meter is not functioning correctly, the Heartbeat LED slows to one pulse per second

4.9: Wiring Diagrams

- Choose the diagram that best suits your application. Diagrams appear on the following pages. If the connection diagram you need is not shown, contact EIG for a custom Connection diagram.

  NOTE: If you purchased a "**G**" Option Nexus® 1250/1252 meter for a 300 Volt secondary, be sure to enable the option on the CT and PT screen of the Communicator EXT software's Device Profile (see Chapter 3 of the *Communicator EXT User Manual* for instructions).

Figure #	Description
4.2	4-Wire Wye, 3-Element Direct Voltage with 4 CTs
4.3	4-Wire Wye, 3-Element with 3 PTs and 4 CTs
4.4	4-Wire Wye, 3-Element with 3 PTs and 3 CTs
4.5	3-Wire, 2-Element Open Delta with 2 PTs and 3 CTs
4.6	3-Wire, 2-Element Open Delta with 2 PTs and 2 CTs
4.7	3-Wire, 2-Element Delta Direct Voltage with 3 CTs
4.8	3-Phase, 4-Wire Wye, 2.5 Element with 2 PTs and 3 CTs
4.9	4-Wire, 3-Element Grounded Delta with 4 CTs – G Option

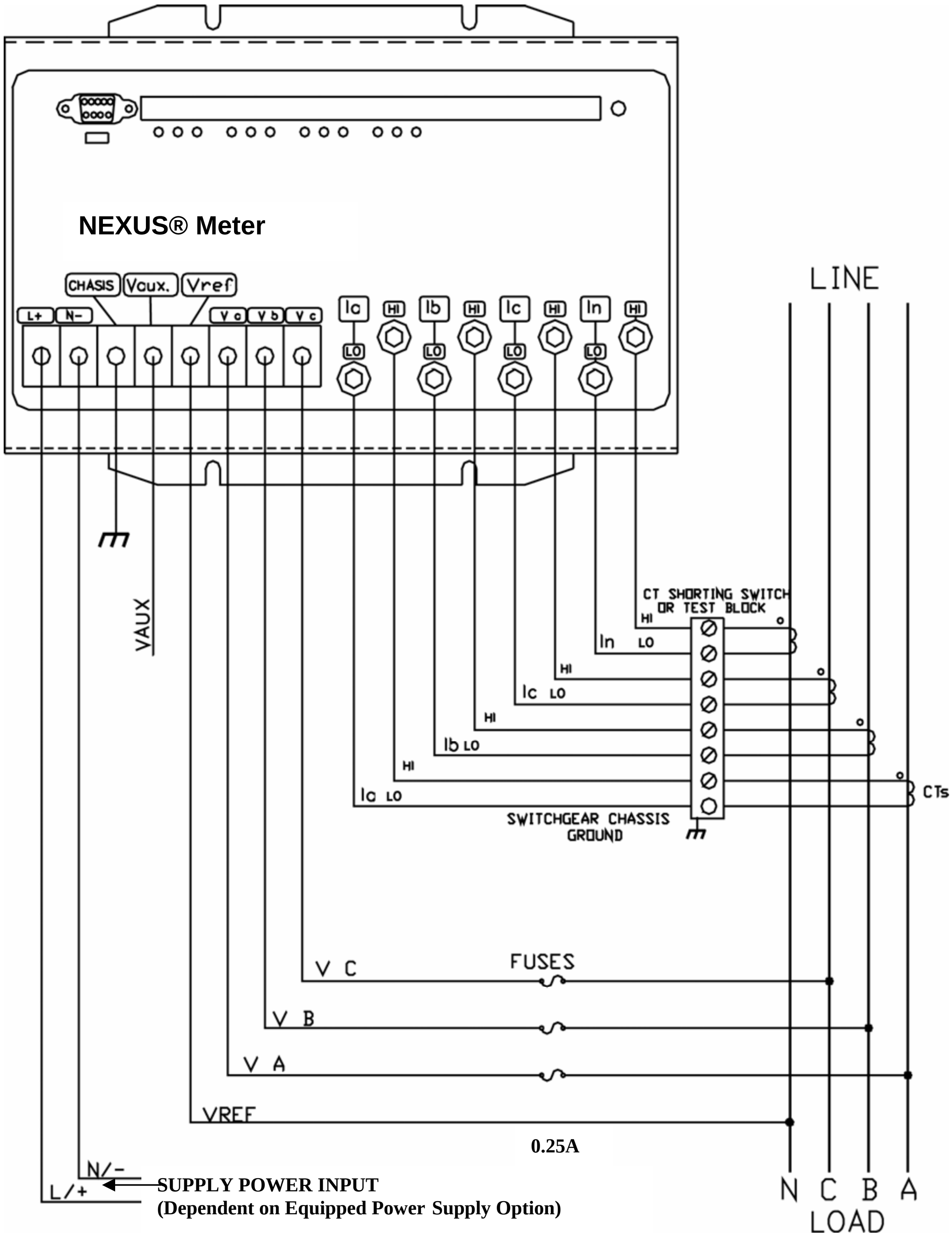


Figure 4.2: 4-Wire Wye, 3-Element Direct Voltage with 4 CTs

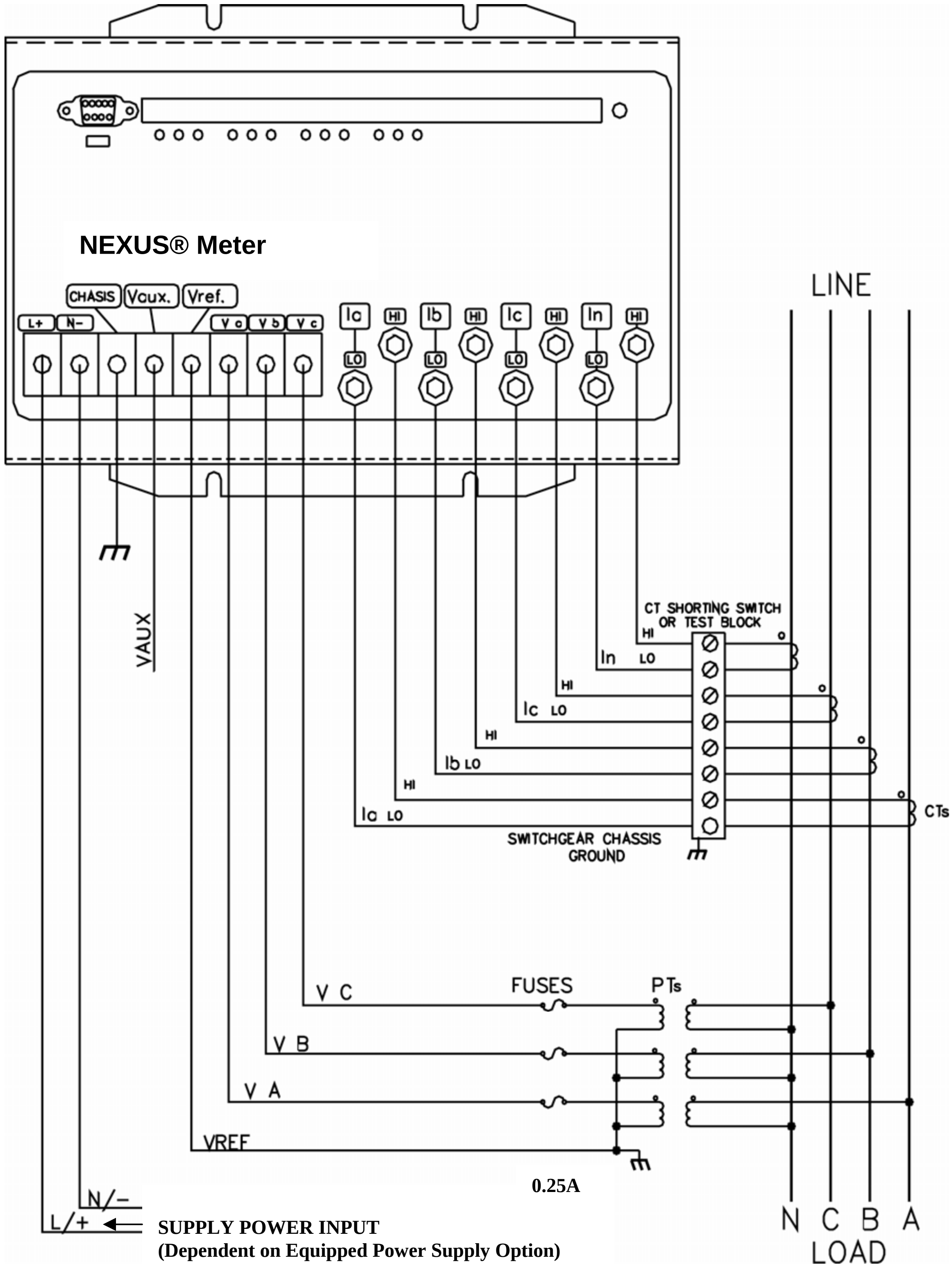


Figure 4.3: 4-Wire Wye, 3-Element with 3 PTs and 4 CTs

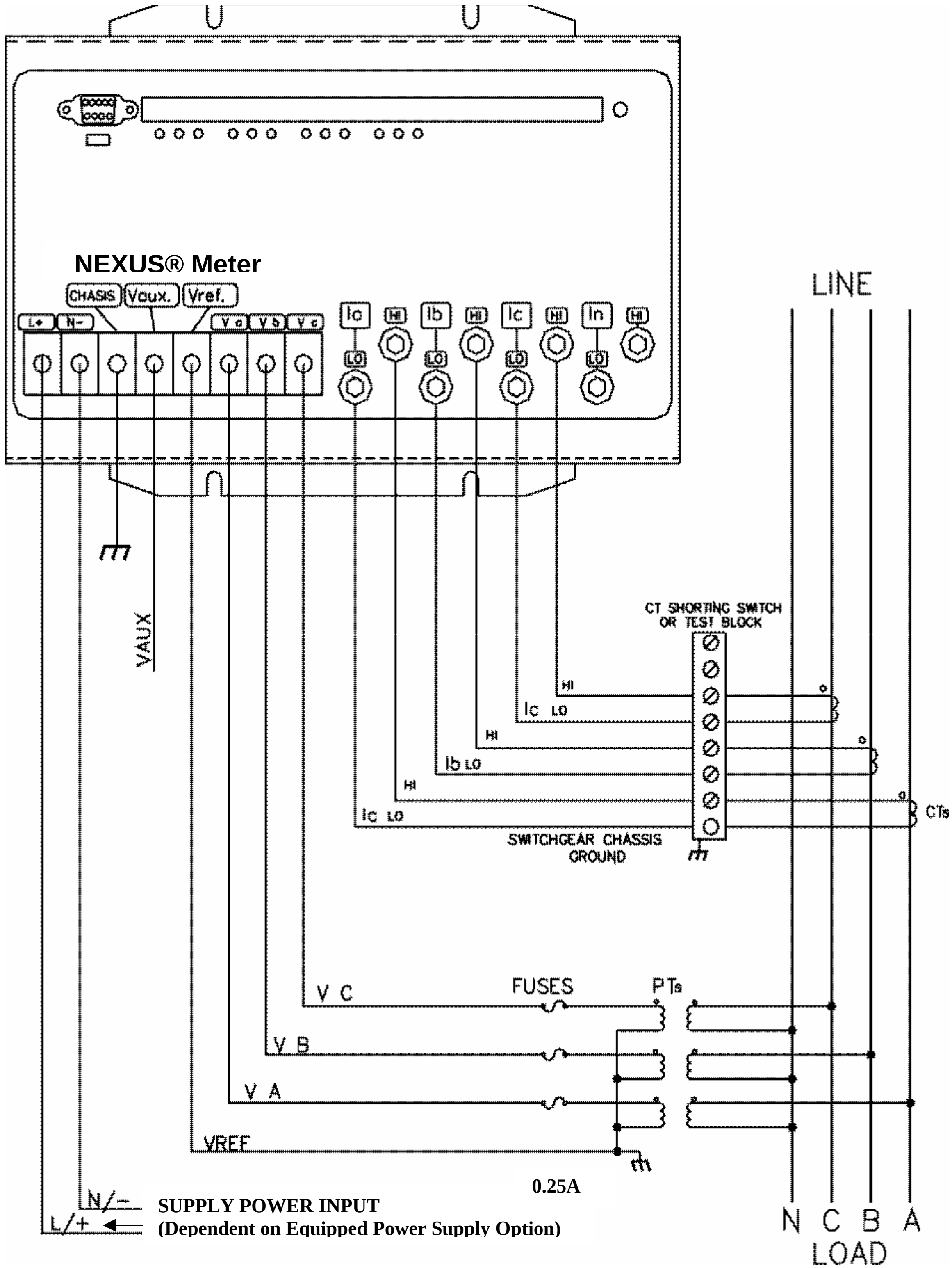


Figure 4.4: 4-Wire Wye, 3-Element with 3 PTs and 3 CTs

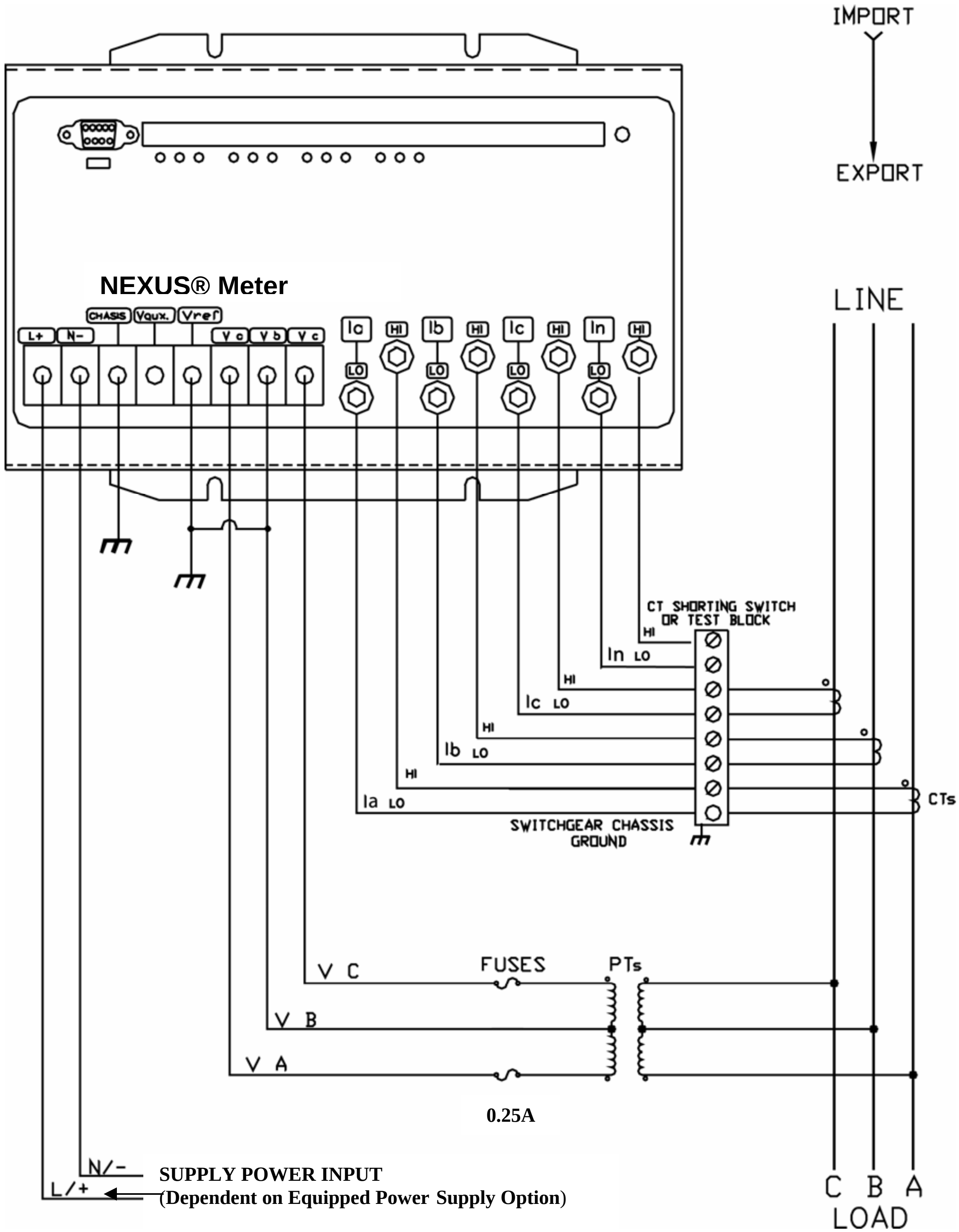


Figure 4.5: 3-Wire, 2-Element Open Delta with 2 PTs and 3 CTs

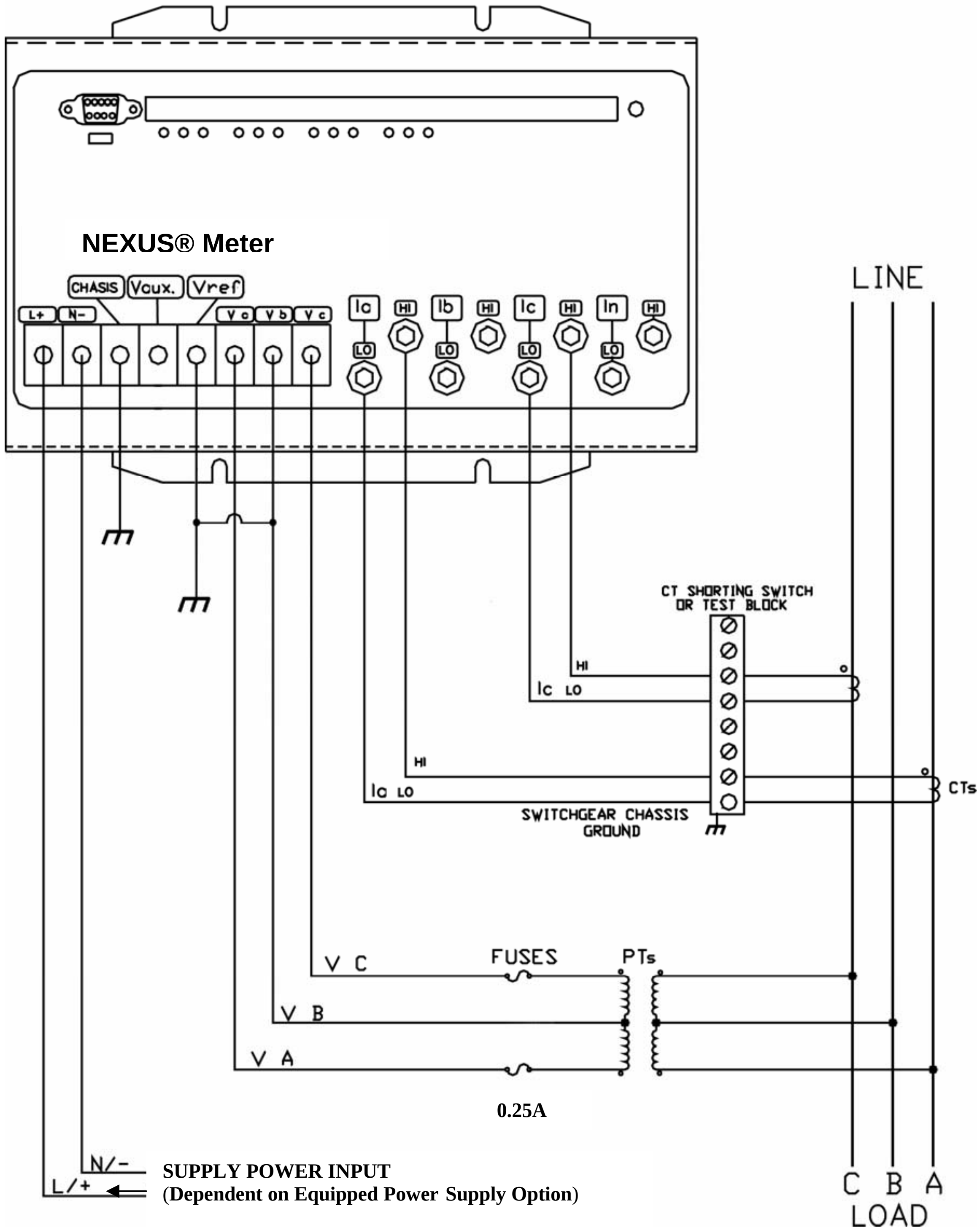


Figure 4.6: 3-Wire, 2-Element Open Delta with 2 PTs and 2 CTs

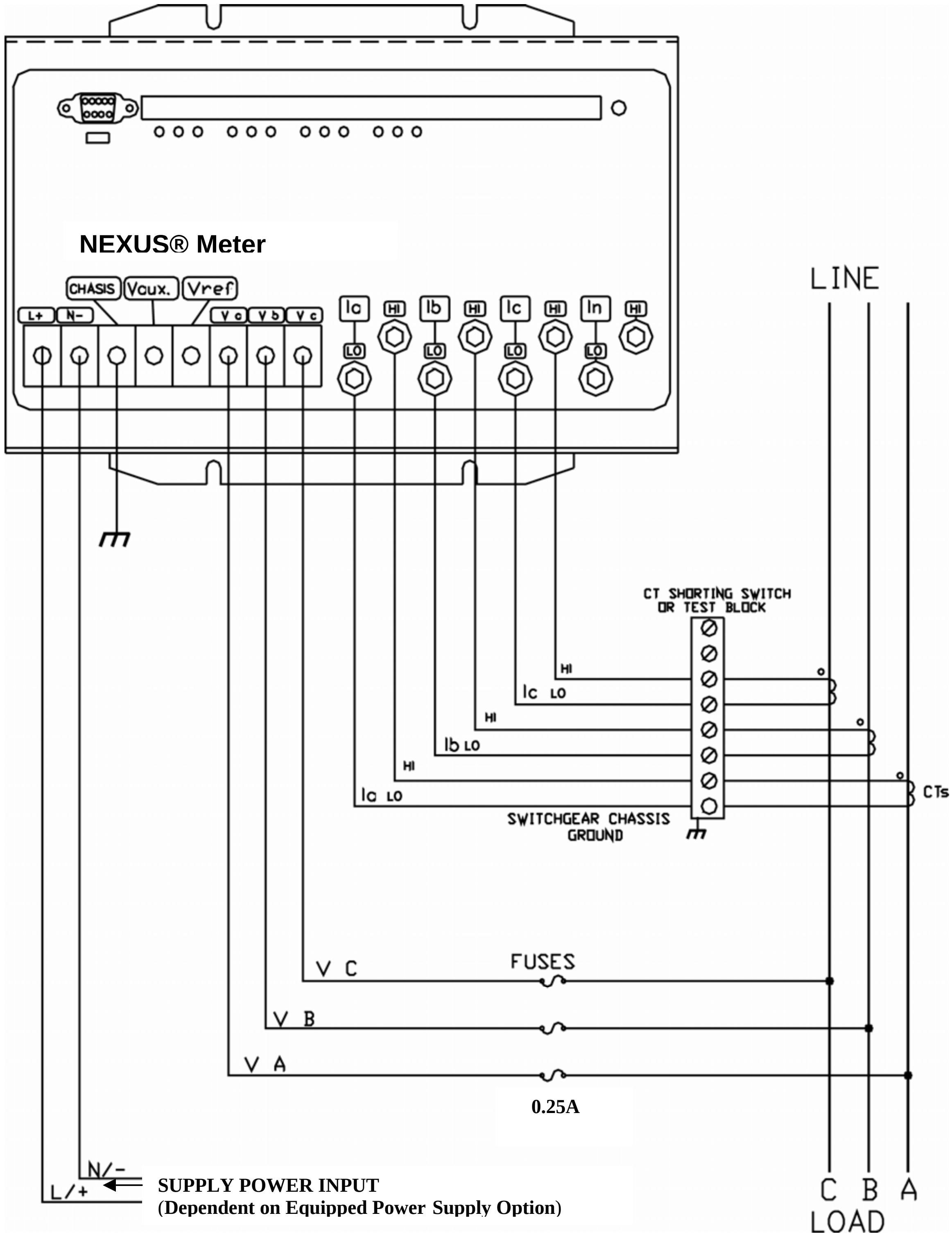


Figure 4.7: 3-Wire, 2-Element Delta Direct Voltage with 3 CTs

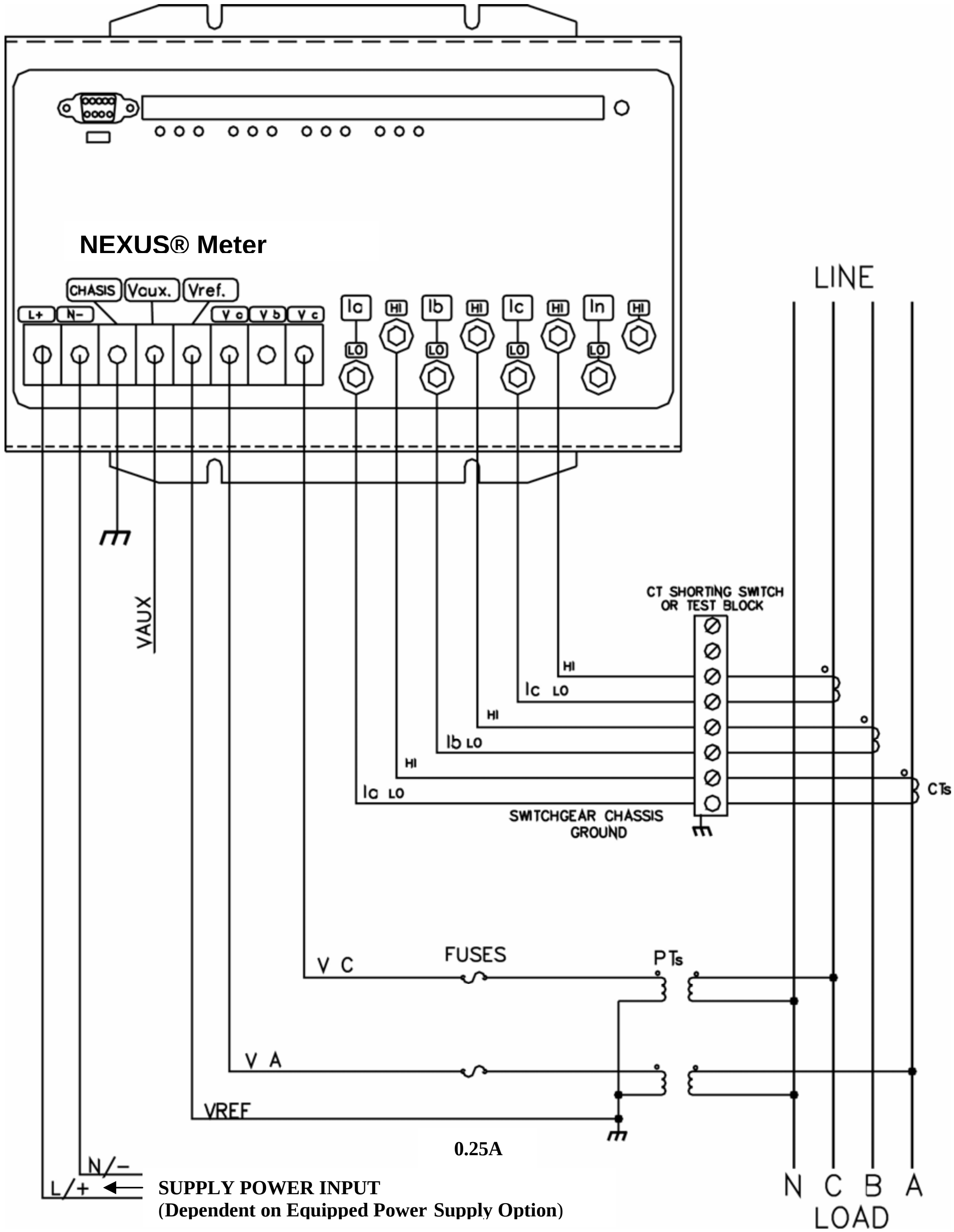


Figure 4.8: 3-Phase, 4-Wire, 2.5 Element with 2 PTs and 3 CTs

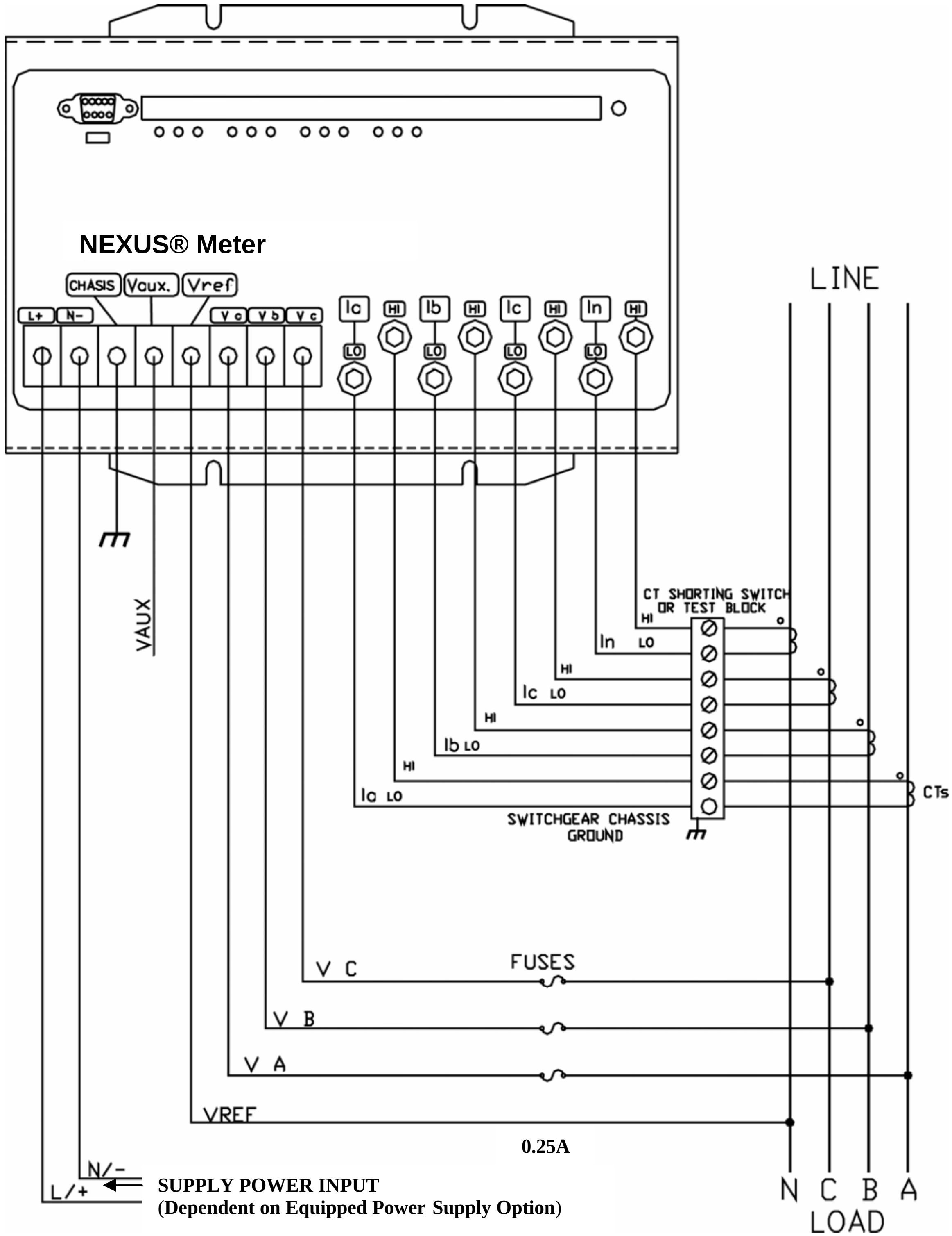


Figure 4.9: 4-Wire, 3-Element Grounded Delta with 4 CTs – G Option

Chapter 5
Communication Wiring

5.1: Communication Overview

- **RS232** communication is used to connect a single Nexus® 1250/1252 meter with another device, such as a computer, RTU or PLC. The link is viable for a distance of up to 50 feet (15.2 m) and is available only through the meter's Port 1. You must set the **selector switch** beneath the port to RS232 (see Figure 5.5).
- **RS485** communication allows multiple Nexus® meters to communicate with another device at a local or remote site. The Output modules and the Nexus® displays use RS485 to communicate with the Nexus® meter. All RS485 links are viable for a distance of up to 4000 feet (1220 m). Ports 1 through 4 on the Nexus® 1250/1252 meter are two-wire, RS485 connections operating up to 115,200 baud. To use Port 1 for RS485, set the **selector switch** to RS485 (see Figure 5.5).

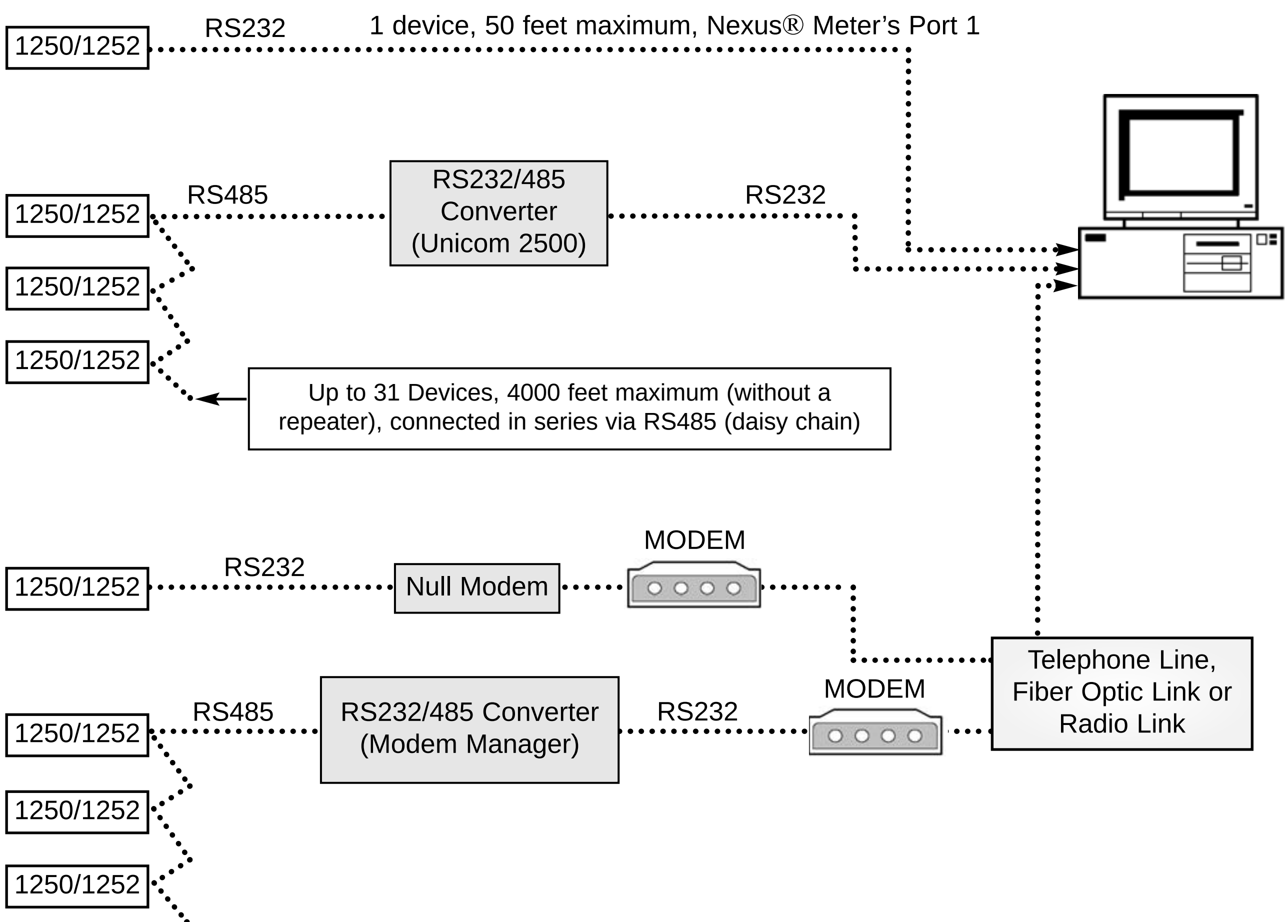


Figure 5.1: Communication Overview

- **RJ-11 Telephone Line** allows a Nexus® 1250/1252 meter with the Internal Modem Option (INP2**)** to communicate with a PC. No other hardware is necessary for this easy-to-use connection. For more details, see Chapter 10 of this manual.

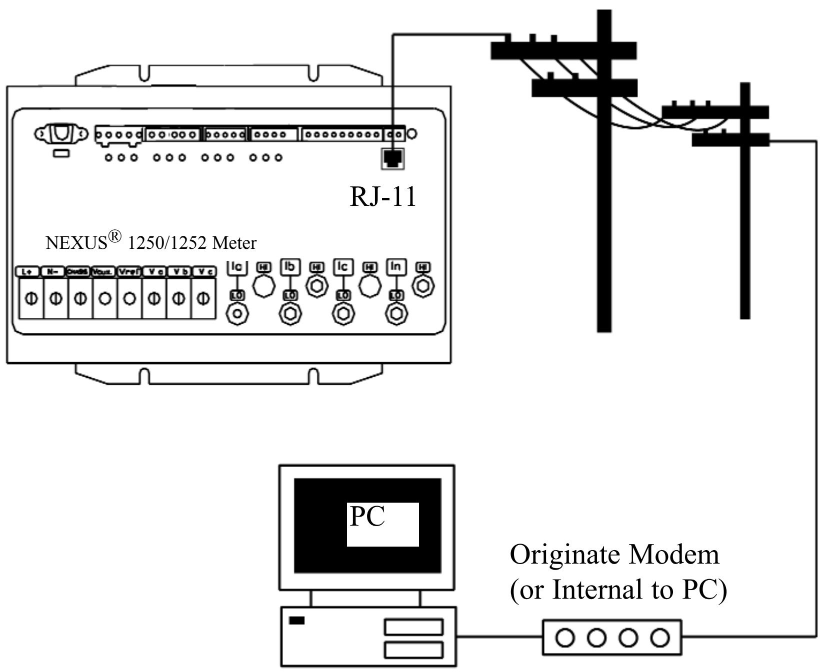


Figure 5.2: RJ-11 Communication with Internal Modem Option

■ **RJ-45 Network Connection** allows a Nexus® 1250/1252 meter with the Internal Network Option (INP200) to communicate with multiple PC's simultaneously. No other hardware is necessary for this easy-to-use connection. For more details, see Chapter 11 of this manual.

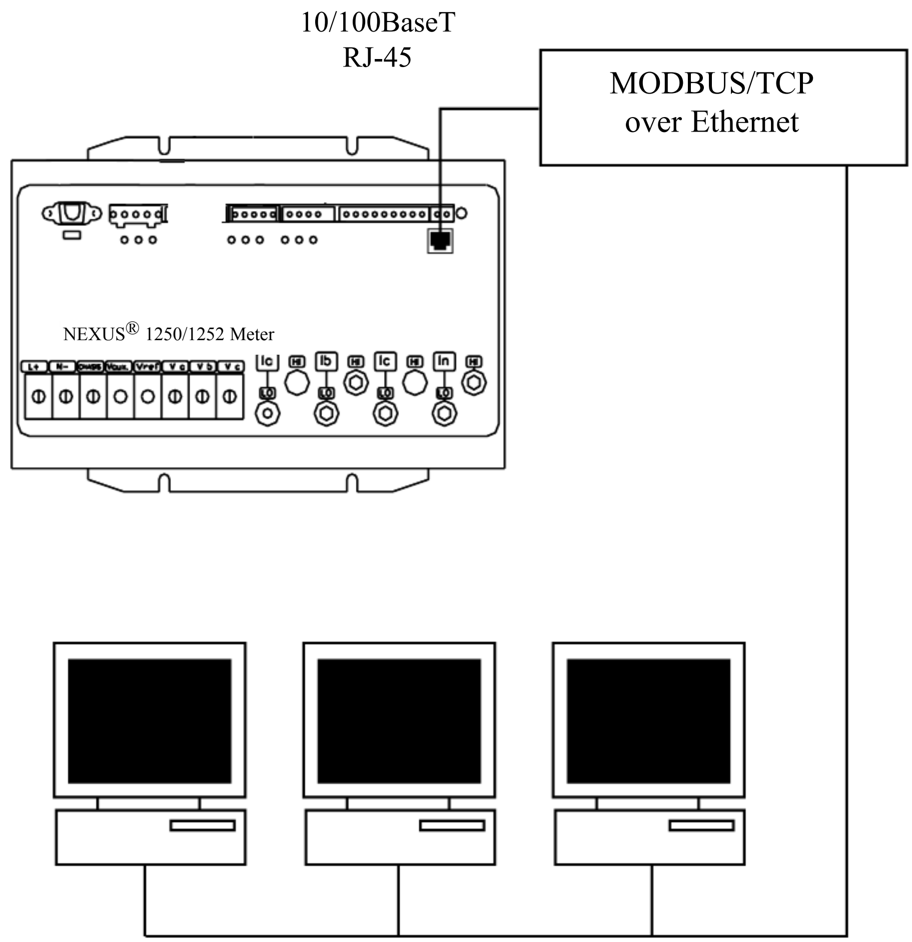
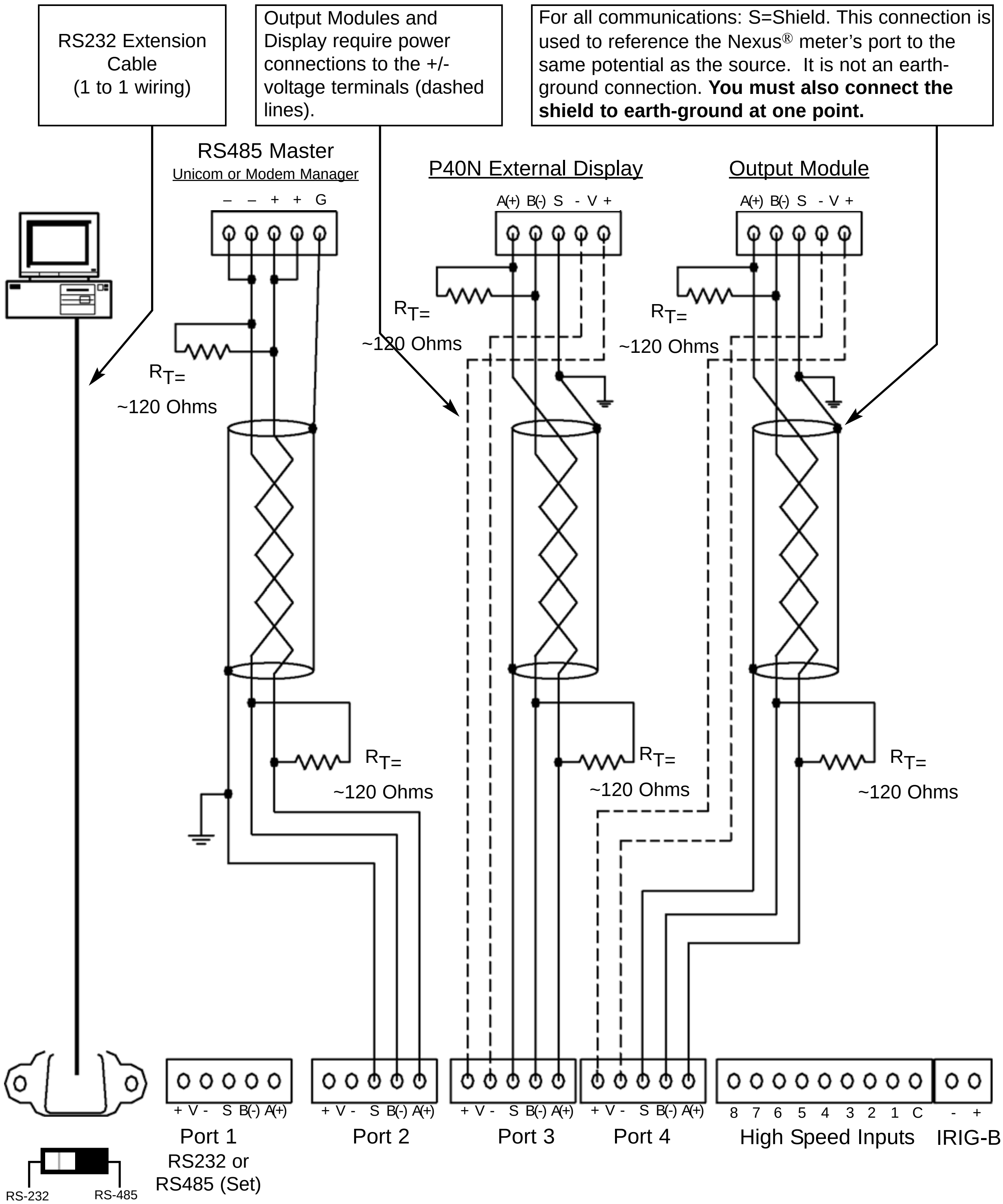


Figure 5.3: RJ-45 Communication with Internal Network Option

NOTE: Nexus 1252® meters can also communicate with DNP 3.0 protocol over Ethernet.



NOTE: You may use ANY port to connect a Nexus® Display or RS485 Master. The Output modules MUST use Port 4 (Port 3 is an alternate).
Nexus® P40N, P41N and P43N displays are shipped programmed to use Port 3—see Section 5.7 for details.

Figure 5.4: Communication Wiring

5.2: RS232 Connection—Nexus® Meter to a Computer

- Use Port 1 for RS232 communication. Set the selector switch beneath the port to RS232.
- Insert one end of an RS232 extension cable into the Nexus® 1250/1252 meter's 9-pin female serial port. Insert the opposite end into a port on the computer.
- The RS232 standard limits the cable length to 50 feet (15.2m).
- The RS232 Port is configured as Data Communications Equipment (DCE).

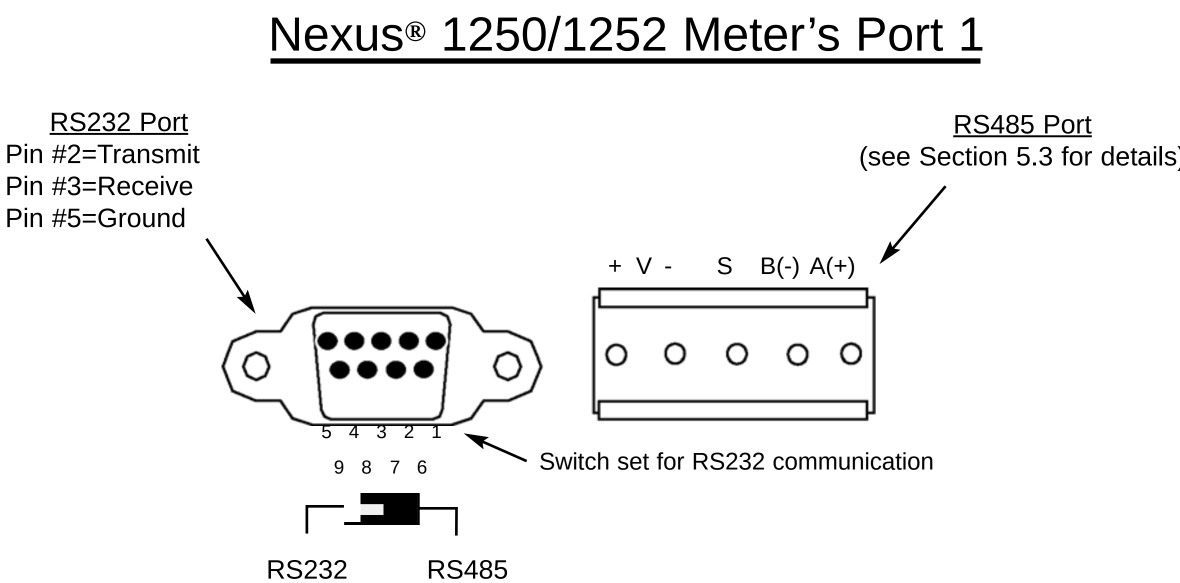


Figure 5.5: Nexus® 1250/1252 Meter's Port 1—RS232/RS485 Communication

5.3: Nexus® Meter RS485 Wiring Fundamentals (with R_T Explanation)

Nexus® 1250/1252 meter's RS485 Ports (Ports 1–4) (see Figure 5.5, above):

+V- **Voltage terminals** for power connections: Use with Nexus® Output Modules and Displays only. The Nexus® 1250/1252 meter supplies 17V DC through the +V- terminal connections.
NOTE: Do **not** connect these pins to devices that receive power from another source—e.g., a computer—or to devices that do not require power to operate.

S **Shield:** The Shield connection is used to reference the meter's port to the same potential as the source. **It is not an earth-ground connection**. **You must also connect the shield to earth-ground at one point**. **Do not** connect the shield to ground at multiple points, as this will interfere with communication.

A(+)/B(-) **Two-wire, RS-485 communication terminals:** Connect the A(+) terminal of the Nexus® meter's port to the **(+)** terminal of the device; connect the B(-) terminal of the Nexus® meter's port to the (-) terminal of the device.

- **RS485** communication allows multiple devices to communicate on a bus. The Nexus® 1250/1252 meter's Ports 1 to 4 are RS485 terminals, viable for a distance of up to 4000 feet (1219 m). (Port 1 can be switched between RS232 and RS485.) Below is a detail of a 2-wire RS485 port.

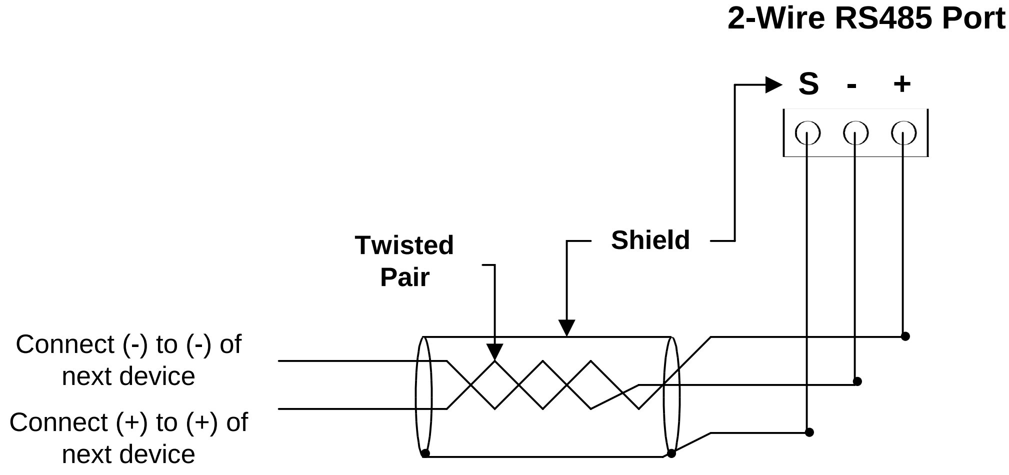


Figure 5.6: 2-Wire RS485 Port Detail

For All RS485 Connections:

- Use a shielded twisted pair cable 22 AWG (0.33 mm²) or larger, grounding the shield at one end only.

- Establish point-to-point configurations for each device on a RS485 bus: Connect (+) terminals to (+) terminals; connect (-) terminals to (-) terminals.

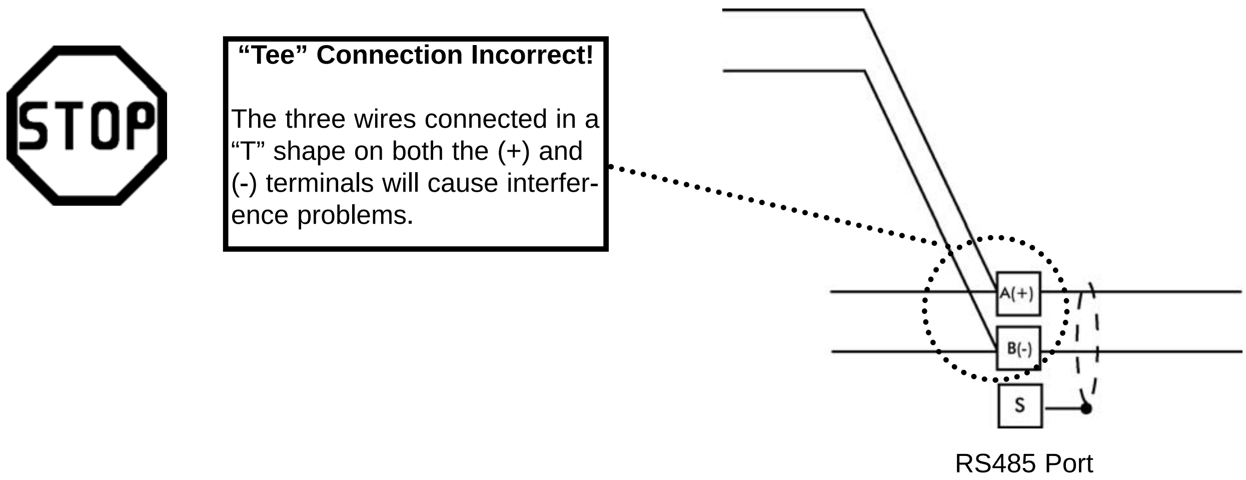
- Protect cables from sources of electrical noise.

- Avoid both "star" and "tee" connections (see Figure 5.7). No more than two cables should be connected at any one point on an RS485 network, whether the connections are for devices, converters or terminal strips.

- Include all segments when calculating the total cable length of a network. If you are not using an RS485 repeater, the maximum length for cable connecting all devices is 4000 feet (1219 meters).

- **RT EXPLANATION:**
  Termination Resistors are generally used on both ends of longer length transmission lines.
  The value of the Termination Resistors is determined by the electrical parameters of the cable.
  Use RTs only on Master and Last Slave when connecting multiple meters in a Daisy Chain.

Incorrect Connection: “T”



Incorrect Connection: “Star”

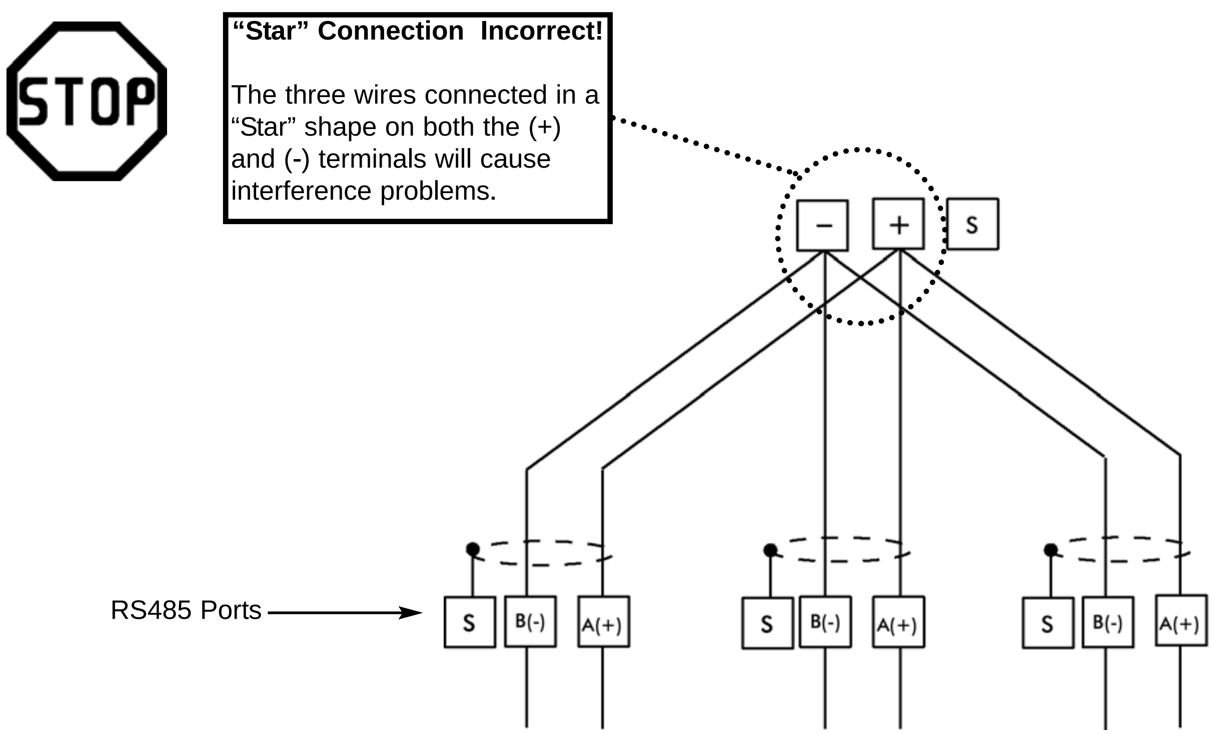


Figure 5.7: Incorrect “T” and “Star” Topologies

5.4: RS485 Connection—Nexus® Meter to a Computer or PLC

- Use any Port on the Nexus® 1250/1252 meter. If you use Port 1, set the selector switch beneath the port to RS485 (see Figure 5.5).
- The link using RS485 is viable for up to 4000 feet (1219 meters).
- You must use an RS485 to RS232 converter, such as EIG's **Unicom 2500**. See Section 5.7.1.
- For information on connecting the Nexus® 1250/1252 meter to a modem, see sections 5.14–5.16.
- **Do not use the V(+)/V(-) pins**: they supply power to the Nexus® displays and Output modules.

5.5: RJ-11 (Telephone Line) Connection—Nexus® Meter with Internal Modem Option (INP2) to a PC

- Use RJ-11 **Standard Telephone Line** to connect with the Nexus® 1250/1252 meter. For details on this connection, see Chapter 10.

5.6: RJ-45 Connection—Nexus® Meter with Internal Network Option (INP200) to Multiple PCs - 10/100BaseT

- The **Internal Network Option** conforms to the **IEEE 802.3**, 10BaseT specification using unshielded twisted pair (UTP) wiring. This allows the use of inexpensive RJ-45 connectors and CAT 3 or better cabling. For details on this connection, see Chapter 11.

5.7: RS485 Connection—Nexus® Meter to an RS485 Master (Unicom or Modem Manager)

- To establish communication between a Nexus® 1250/1252 meter and any RS485 master, such as EIG's Unicom 2500, **Modem Manager** or other RS232/RS485 converter, use a shielded, twisted pair cable.

- Use an RS485 port (Ports 1–4) on the Nexus® meter. If you use Port 1, set the selector switch beneath it to RS485 (see Figure 5.5). Connect the A(+) and B(-) terminals on the meter to the (+) and (-) terminals on the master. Provide jumpers on the master, linking its two (-) terminals and two (+) terminals. RS485 communication is viable for up to 4000 feet (1219 meters).

- Connect the shield to the Ground (G) terminal on the Master. The (S) terminal on the Nexus® meter is used to reference the Nexus® meter's port to the same potential as the source. **It is not an earth-ground connection**. **You must also connect the shield to earth-ground at one point**.

- Provide resistors at each end, connected to the (+) and (-) lines. RT is approximately 120 Ohms, but this value may vary based on length of cable run, gauge and the impedance of the wire.
  NOTE: Refer to Section 5.3 for information on using RTs.

5.7.1: Using the Unicom 2500

The **Unicom 2500** provides **RS485/RS232 conversion**. In doing so it allows the Nexus® 1250/1252 meter to communicate with a PC or other device. See the *Unicom 2500 Installation and Operation Manual* for additional information.

Figures 5.8 and 5.9, on the next page, illustrate the Unicom 2500 connections for RS485.

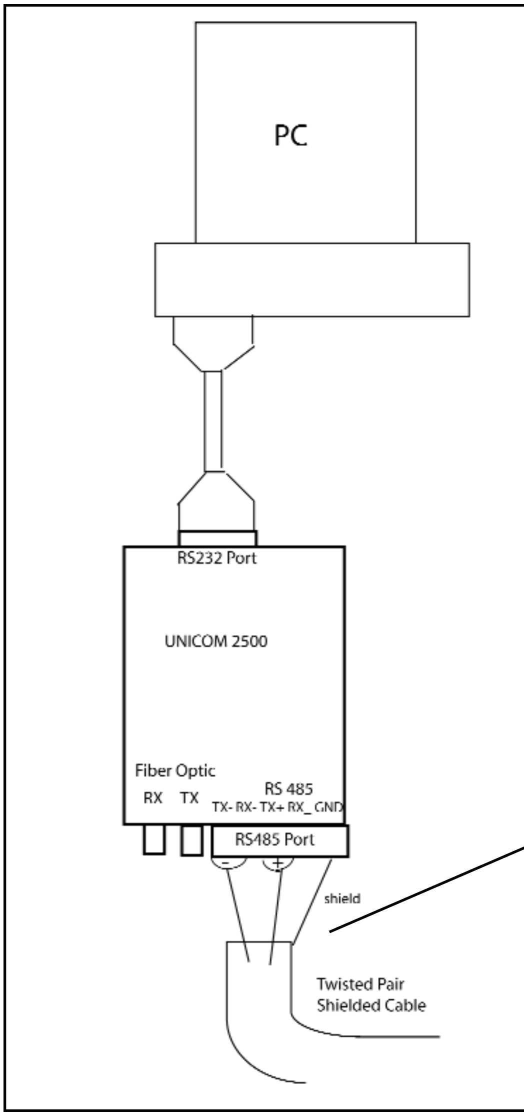


Figure 5.8: Unicom 2500 with Connections

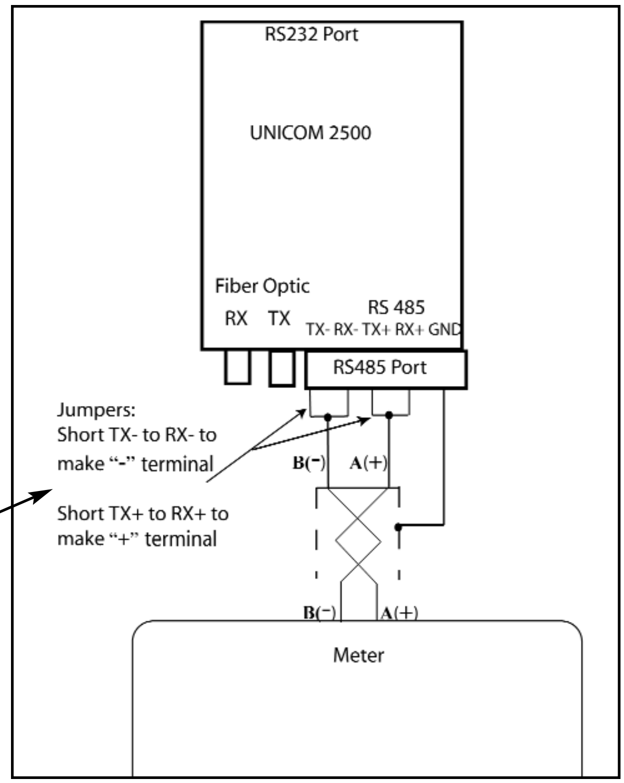


Figure 5.9: Detail of "Jumpers"

The Unicom 2500 can be configured for either 4-wire or 2-wire RS485 connections. Since the Nexus® meter uses a 2-wire connection, you need to add jumper wires to convert the Unicom 2500 to the 2-wire configuration.

As shown in Figure 5.9, you connect the "RX-" and "TX-" terminals with a jumper wire to make the "-" terminal, and connect the "RX+" and "TX+" terminals with a jumper wire to make the "+" terminal.

5.8: RS485 Connection—Nexus® Meter to the Nexus® P40N External Display

- Insert one end of the supplied RS485 cable into Port 3 of the Nexus® 1250/1252 meter. Port 3 is factory-set to match the Nexus® display's baud rate of 9600. To use a port other than Port 3, you must set the port's baud rate to 9600 using the Communicator EXT software (see Chapter 3 of the *Communicator EXT User Manual* for instructions). Insert the other end of the cable into the back of the Nexus® **P40N**, **P41N** or **P43N** display. (The connectors fit only one way into the ports.)

- The cable harness brings 17V DC to the displays from the Nexus® meter, represented by dashed lines in the figure below. RS485 communication is viable for up to 4000 feet (1219 meters). If your cable length exceeds 200 feet you must use a remote power supply, such as EIG's **PSIO**, and:

  a. Connect the shield to the shield (S) terminal on the Nexus® display port. The (S) terminal on the Nexus® meter is used to reference the Nexus® meter's port to the same potential as the source. **It is not an earth-ground connection. You must also connect the shield to earth-ground at one point.**

  b. Provide termination resistors at each end, connected to the A(+) and B(-) lines. RT is approximately 120 Ohms.
  NOTE: Refer to Section 5.3 for information on using RTs.

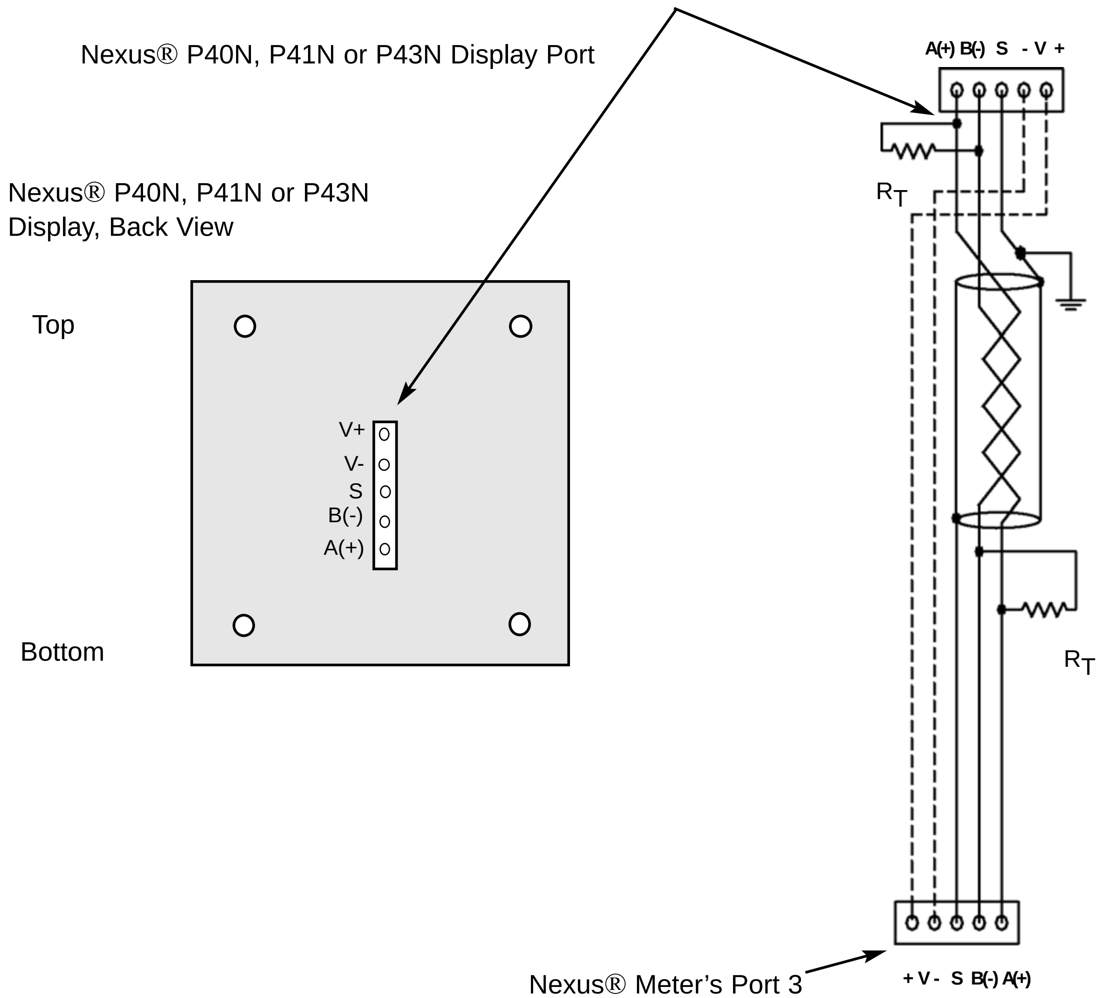
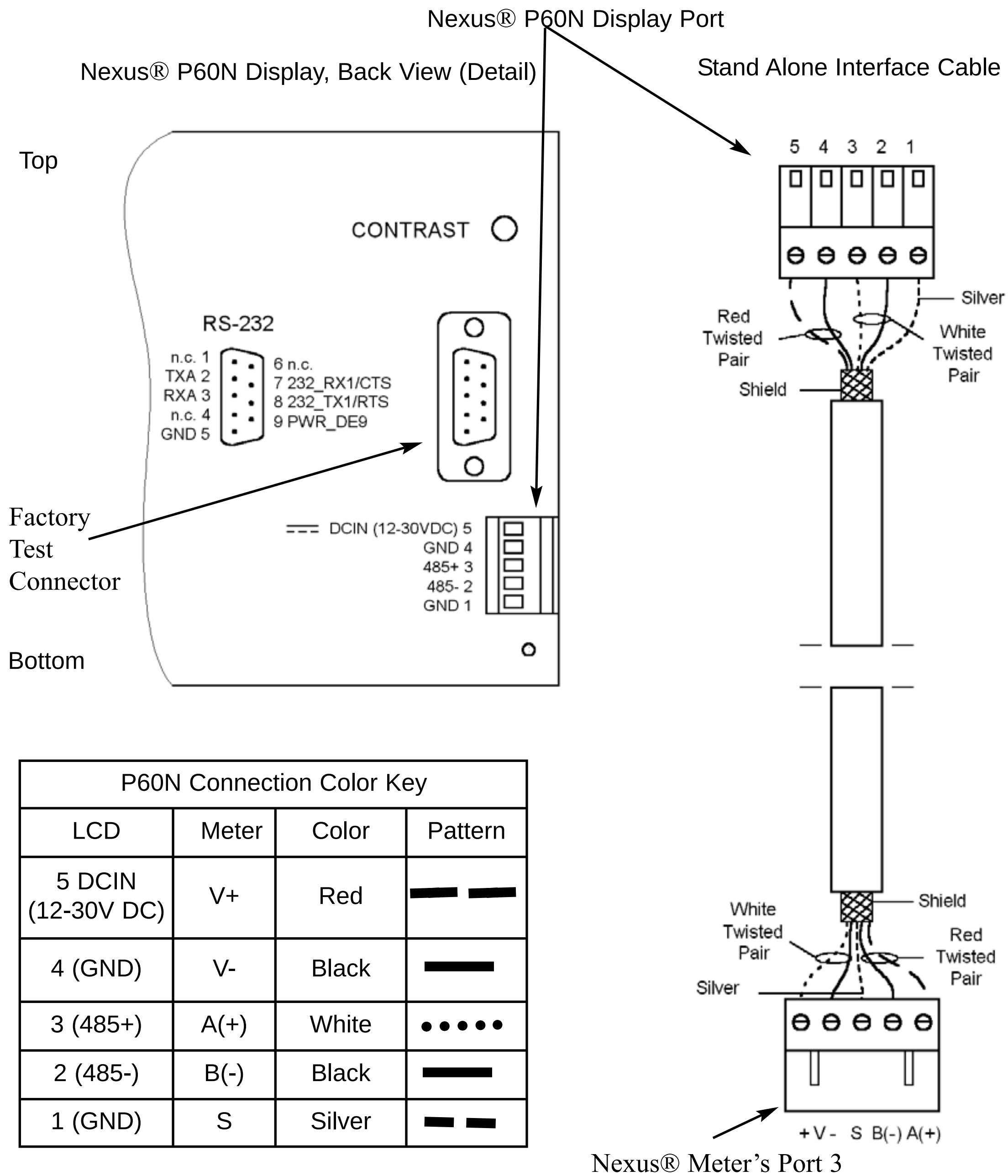


Figure 5.10: Nexus® Meter Connected to Nexus® P40N, P41N or P43N External Display

5.9: RS485 Connection—Nexus® Meter to the Nexus® P60N External Display

- To connect the Nexus® **P60N** Touch Screen External Display, use the Stand Alone Interface Cable provided with the display. The cable is six (6) feet long with 20 AWG conductors (see detailed figure, below). Insert one end of the cable into Port 3 of the Nexus® 1250/1252 meter. Port 3 is factory-set to match the Nexus® display's baud rate of 9600. To use a port other than Port 3, you must set the port's baud rate to 9600 using the Communicator EXT software (see Chapter 3 of the *Communicator EXT User Manual*). Insert the other end of the cable into the back of the Nexus® P60N display. (The connectors fit only one way into the ports.)



P60N Connection Color Key			
LCD	Meter	Color	Pattern
5 DCIN (12-30V DC)	V+	Red	▬ ▬
4 (GND)	V-	Black	▬▬
3 (485+)	A(+)	White	●●●●●
2 (485-)	B(-)	Black	▬▬
1 (GND)	S	Silver	▬ ▬

Figure 5.11: Nexus® 1250/1252 Meter Connected to Nexus® P60N Touch Screen Display

5.10: Communication Ports on the Nexus® Output Modules

- **Female RS485 Side Port**: use to connect to another module's female RS485 side port.
- **Male RS485 Side Port**: use to connect to the Nexus® meter's Port 4 (see Section 5.8) or to connect to another module's male RS485 side port.
- **Output Port**: use for functions specific to the type of module; size and pin configuration varies depending on type of module. For more detail, refer to following Section 5.11, and to Chapter 9 of this manual.

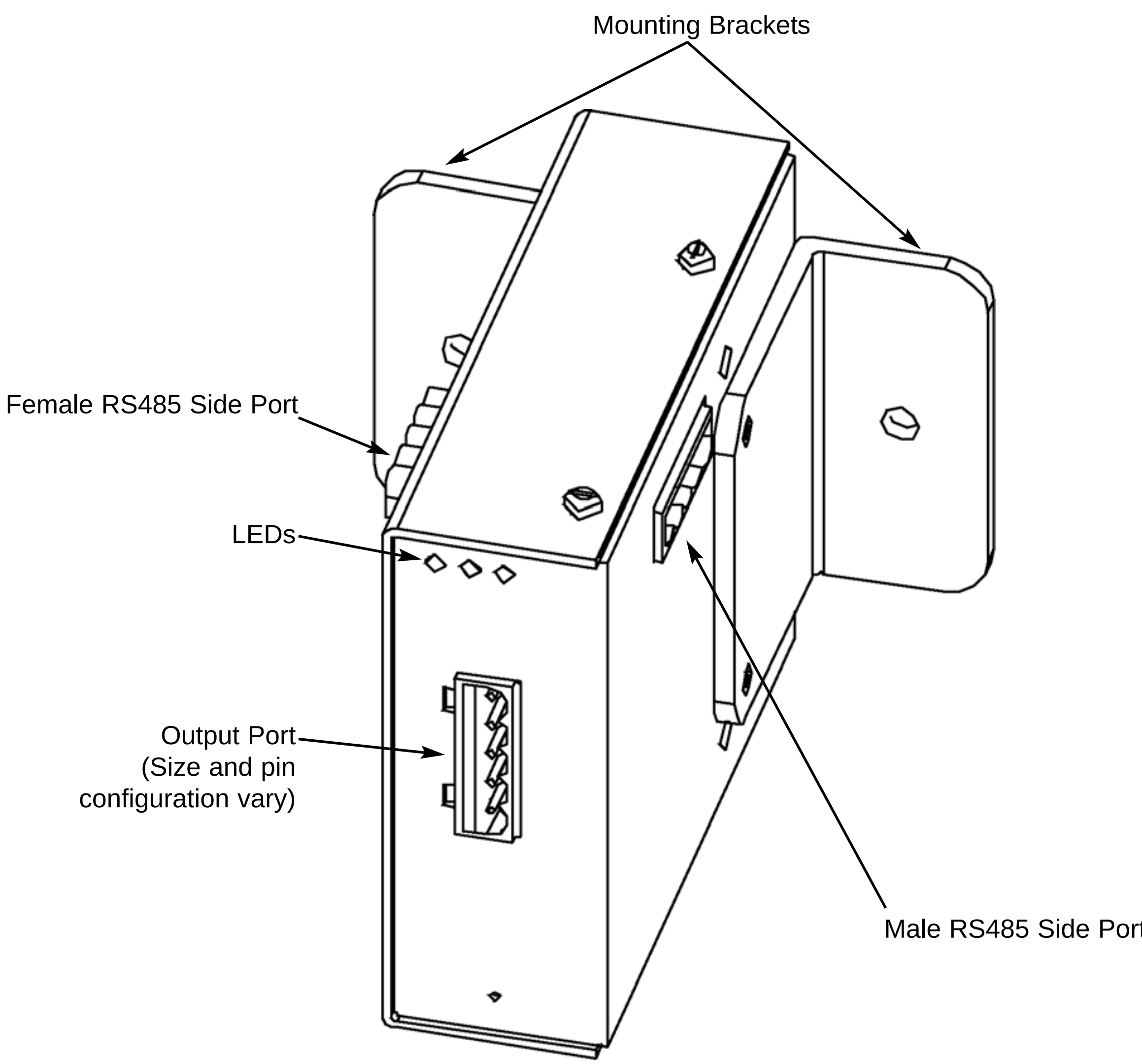


Figure 5.12: Communication Ports on the Nexus® Output Modules

5.11: RS485 Connection—Nexus® Meter to Nexus® Output Modules

- Six feet of RS485 cable harness is supplied. Insert one end of the cable into Port 4 of the Nexus® 1250/1252 meter.
- Insert the other end of the cable into the Output module's female RS485 side port (see Figure 5.9). (The connectors fit only one way into the ports.)
- Use the male RS485 side port to attach another Output module. The Nexus® 1250/1252 meter can power up to four connected Output modules using 15–20V DC at 50–200mA, represented by dashed lines in the figure below. Use the steps in Section 5.12 to determine if you must use a separate power source (for example, **EIG's PSIO**) to supply added power to the group. RS485 communication is viable for up to 4000 feet (1219 meters). However, if your cable length exceeds 200 feet, use the remote power supply and:

  a. Connect the A(+) and B(-) terminals on the Nexus® meter to the A(+) and B(-) terminals of the female RS485 port. Connect the shield to the shield (S) terminal. The (S) terminal on the Nexus® meter is used to reference the meter's port to the same potential as the source. **It is not an earth-ground connection. You must also connect the shield to earth-ground at one point.**

  b. Provide termination resistors at each end, connected to the A(+) and B(-) lines. RT is approximately **120** Ohms.
  NOTE: Refer to Section 5.3 for information on using RTs.

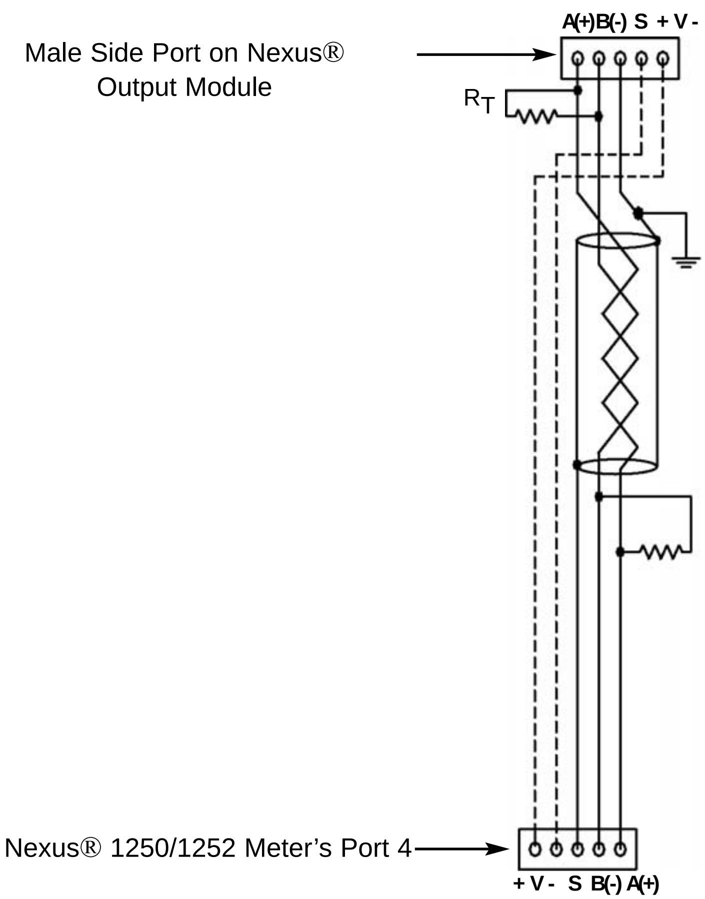


Figure 5.13: Nexus® 1250/1252 Meter Connected to Nexus® Output Module

5.12: Steps to Determine Power Needed

Available power for all ports of the Nexus® 1250/1252 meter is **12 VA**.

1. Refer to the table below to determine the VA Ratings for Output modules and displays.
2. Add together the VA Ratings for Output modules and displays in use.
3. Compare available power to power needed to determine if you must use an additional power source.

NOTE: EIG recommends the **PSIO** 12V power source. See Section 9.2.1 for information and instructions.

5.13: Output Modules' Factory Settings and VA Ratings

■ All Output modules are shipped pre-programmed with a baud rate of 57600 and addresses. The table below details the factory-set address for each module and the VA Ratings for Output modules and Nexus® displays. Refer to the previous section (Section 5.12) for the steps to determine if you must use an additional power source. For programming instructions, refer to Chapter 8 of the *Communicator EXT User Manual.*

OUTPUT MODULES' FACTORY SETTINGS AND VA RATINGS			
MODEL NUMBER	MODULE	ADDRESS	VA RATING
1mAON4	0-1mA, 4 Analog Outputs	128	2.7 VA
1mAON8	0-1mA, 8 Analog Outputs	128	3.2 VA
20mAON4	4-20mA, 4 Analog Outputs	132	5.0 VA
20mAON8	4-20mA, 8 Analog Outputs	132	8.5 VA
4RO1	4 Latching Relay Outputs	156	2.7 VA
4PO1	4 KYZ Pulse Outputs	160	2.7 VA
NEXUS® DISPLAYS' VA RATINGS			
P40N, P41N or P43N	Nexus® LED Display		8 VA
P60N	Nexus® Touch Screen Display		5 VA

5.14: Linking Multiple Nexus® Meters in Series

- You may connect a total of **31** Nexus® meters in series on a single bus using RS485. The cable length may not exceed 4000 feet (1219 meters). Before assembling the bus, each Nexus® meter must be assigned a unique address. See Chapter 3 of the *Communicator EXT User Manual* for instructions.
- Connect the A(+) and B(-) terminals of each Nexus® meter. Use jumpers on any RS485 Master connected at the end of the chain (see Section 5.5).
- Connect the shield to the (S) terminal on each Nexus® meter and to the Ground on the RS485 Master. This connection is used to reference the Nexus® meter's port to the same potential as the source. **It is not an earth-ground connection. You must also connect the shield to earth-ground at one point.**
- Provide termination resistors at each end, connected to the (+) and (-) lines. RT is approximately 120 Ohms, but this value may vary based on length of cable run, gauge or the impedance of the wire. **NOTE**: Refer to Section 5.3 for RT Explanation.

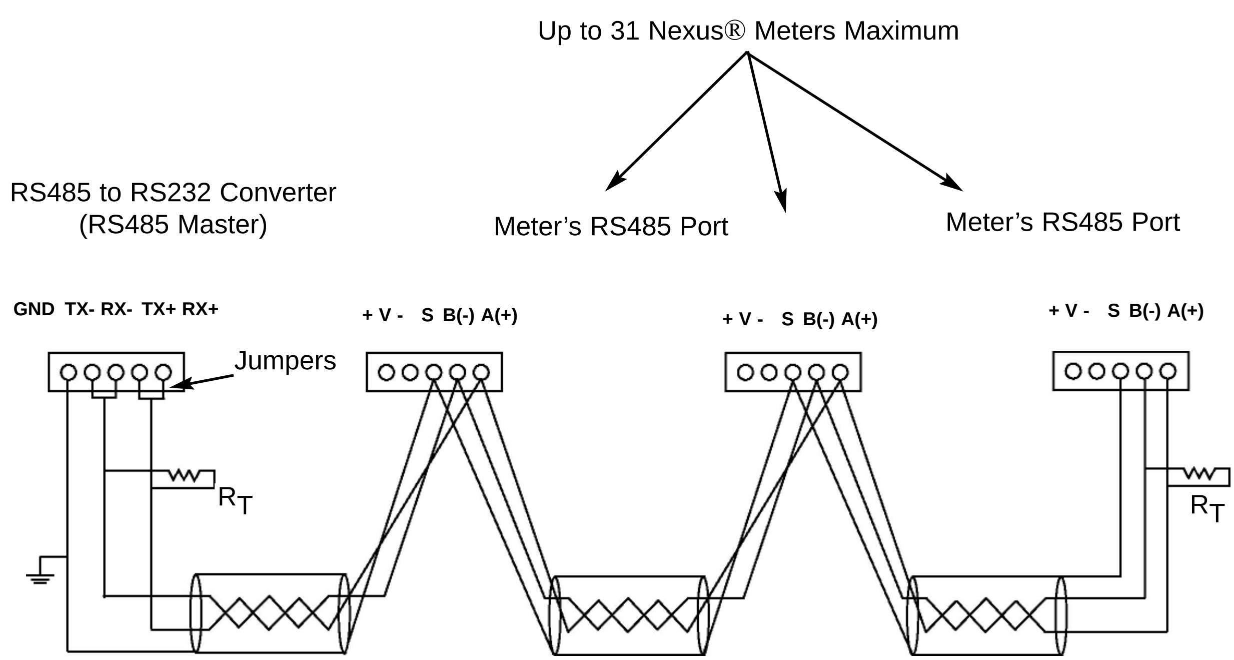


Figure 5.14: Linking Multiple Nexus® Meters in Series

■ You can use an RS485 repeater to network several links of instruments.

NOTES:

- A maximum number of 31 Nexus® meters may be connected to one repeater.
- A maximum number of 31 repeaters may be included on the same network.

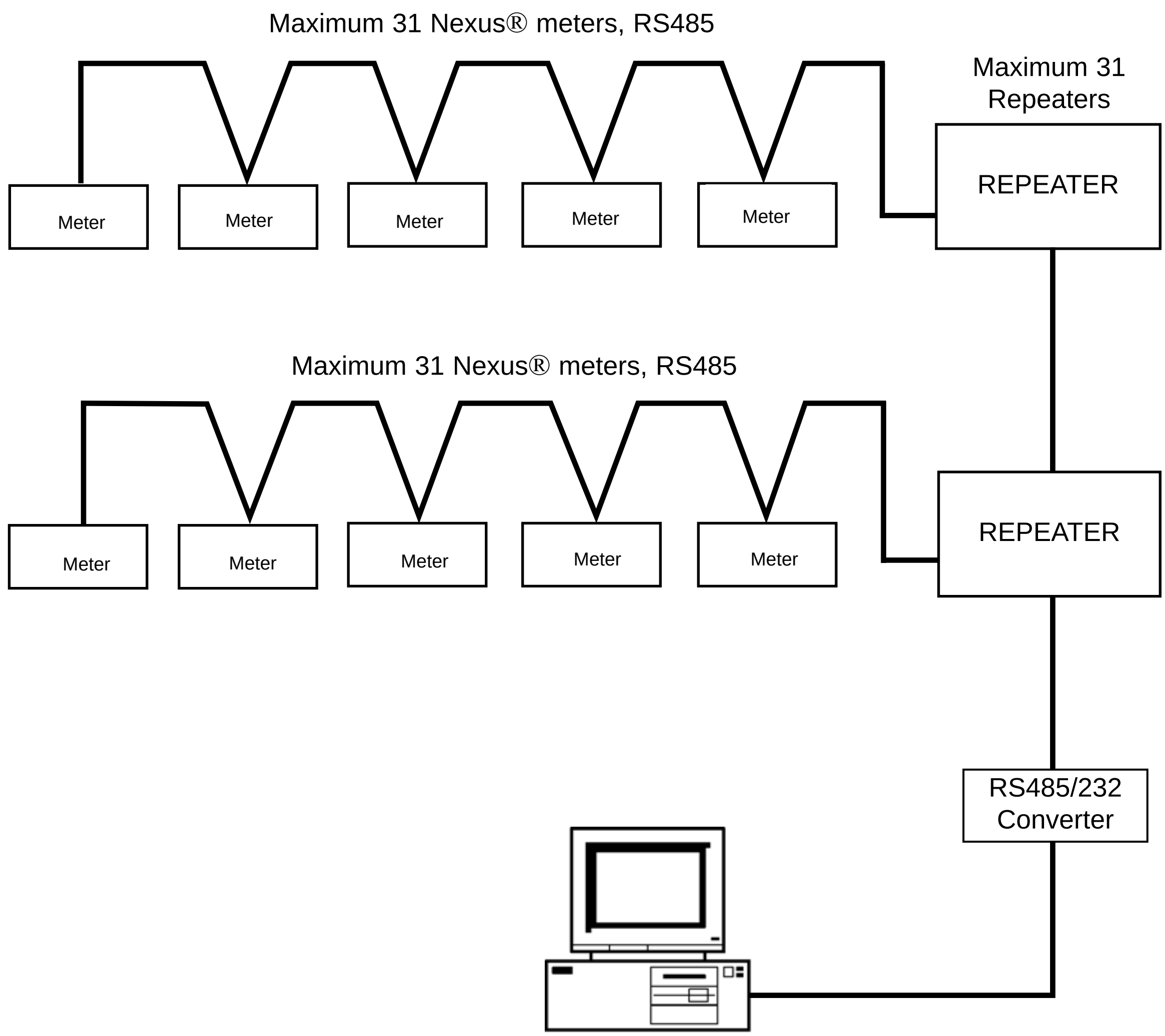
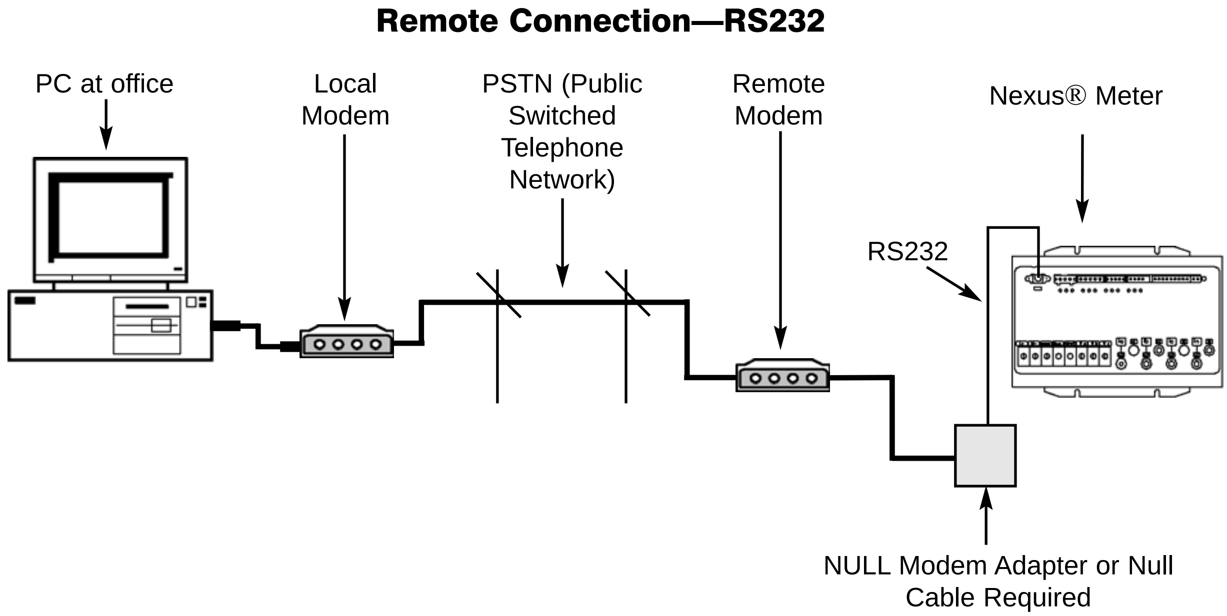


Figure 5.15: Networking Groups of Nexus® Meters

5.15: Remote Communication Overview

- Either **RJ-11** (INP2 Option) or **RJ-45** (INP200 Option) can connect devices at great distances**.** Section 5.1 gives an overview of these communication options. Chapter 10 explains the **INP2** Internal Modem Option; Chapter 11 explains the **INP200** Network Option.
  You can use also use **modems** to connect devices. **EIG recommends using RS485 wiring with a Modem Manager.** See Section 5.17 for additional information.



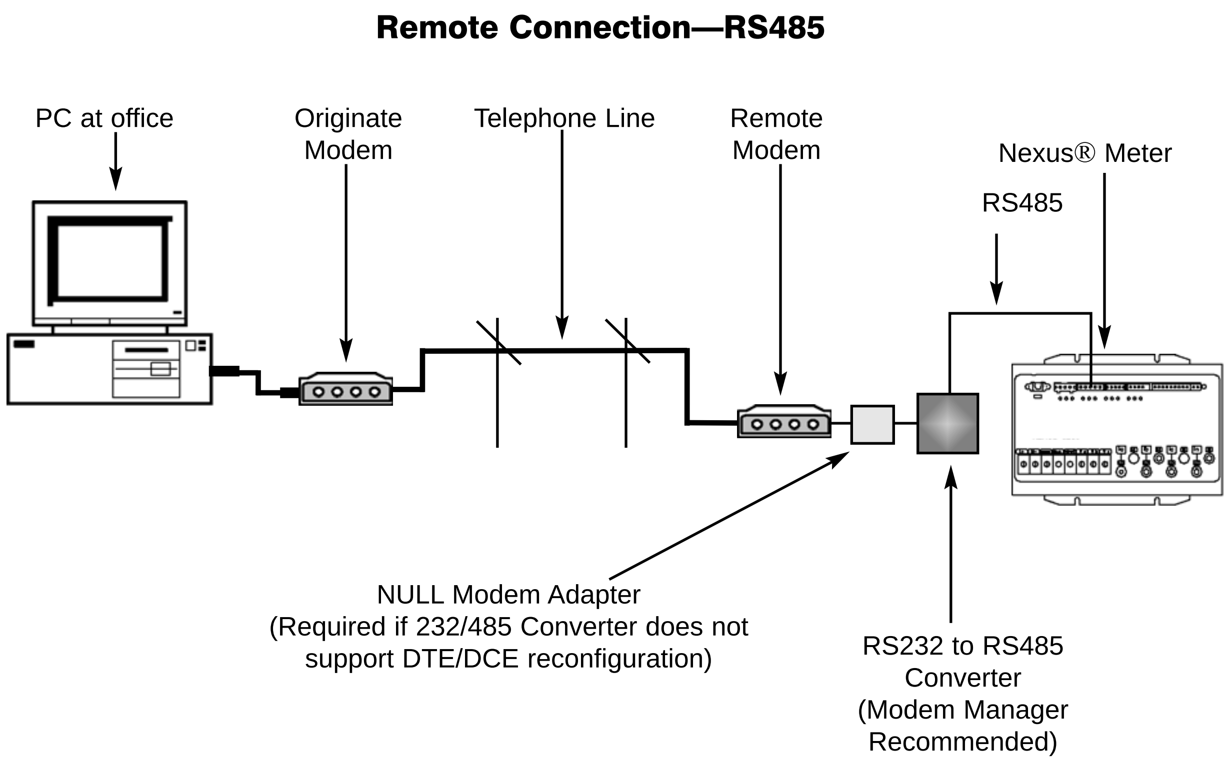


Figure 5.16: Remote Connections—RS232/RS485

5.16: Remote Communication—RS232

NOTE: EIG recommends using RS485 wiring with a Modem Manager. See Section 5.17.

- For **RS232** communication, use Port 1. Set the selector switch under the port to RS232 (Fig. 5.5).

- Use a RS232 serial extension cable connected to the 9-pin female serial port of the Nexus® 1250/1252 meter's Port 1. Program this port for Modbus ASCII. See Chapter 3 of the *Communicator EXT User Manual* for details.

- The link using RS232 is viable for up to 50 feet (1219 meters).

- You must use a Null Modem or Null Cable between the Nexus® meter and the remote modem when using RS232. A Null Modem enables two DCE devices to communicate. The figure below details how a null modem reconfigures the RS232 pins.
  NOTE: Connecting the Nexus® meter to a modem via RS485 protocol with EIG's Modem Manager converter eliminates the need for a Null Modem (see Section 5.17).

- The remote modem must be programmed for auto-answer and set at a fixed baud rate of 9600 with no Flow Control. See Section 5.18 and the *Communicator EXT User Manual* for further details.

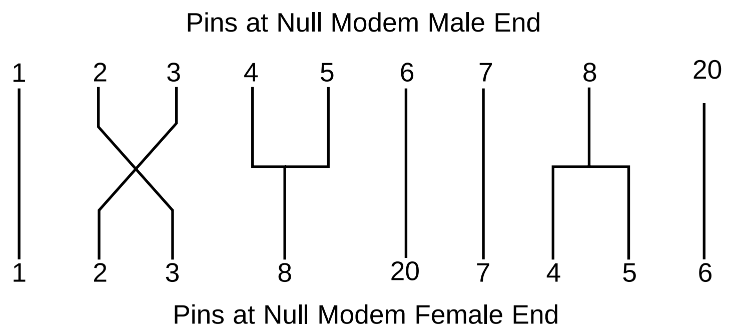


Figure 5.17: Standard Null Modem Configuration

5.17: Remote Communication-RS485

- Use any Port on the Nexus® 1250/1252 meter. If you use Port 1, set the selector switch beneath the port to RS485 (see Figure 5.5). The link using RS485 is viable for up to 4000 feet (1219 meters).

- Use **Communicator EXT** software to set the port's baud rate to 9600 and enable Modbus ASCII protocol. See Chapter 3 of the *Communicator EXT User Manual* for instructions.

- You must use an RS485 to RS232 converter and a Null Modem. EIG recommends using its **Modem Manager**, a sophisticated RS232/RS485 converter that enables devices with different baud rates to communicate. It also eliminates the need for a Null modem (see Section 5.16), and automatically programs the modem to the proper configuration. Also, if the telephone lines are poor, Modem Manager acts as a line buffer, making the communication more reliable.

5.18: Programming Modems for Remote Communication

When a modem speaks to most RS485 or RS232-based devices, it must be programmed for the communication to work. This task is often quite complicated because modems can be unpredictable when communicating with remote devices.

If you are not using the EIG Modem Manager device, you must set the following strings to communicate with the remote Nexus® meter(s). Consult your modem's manual for the proper string settings or see Section 5.19 for a list of selected modem strings.

■ **Modem Connected to a Computer** (the **Originate** Modem):

- Restore modem to factory settings. This erases all previously programmed settings.
- Set modem to display Result Codes. The computer will use the result codes.
- Set modem to Verbal Result Codes. The computer will use the verbal result codes.
- Set modem to use DTR Signal. This is necessary for the computer to ensure connection with the originate modem.
- Set modem to enable Flow Control. This is necessary to communicate with remote modem connected to the Nexus® meter.
- Instruct modem to write the new settings to activate profile. This places these settings into nonvolatile memory; the setting will take effect after the modem powers up.

■ **Modem Connected to the Nexus® Meter** (the **Remote** Modem):

- Restore modem to factory settings. This erases all previously programmed settings.
- Set modem to auto answer on *n* rings. This sets the remote modem to answer the call after *n* rings.
- Set modem to ignore DTR Signal. This is necessary for the Nexus® meter, to insure connection with originate modem.
- Set modem to disable Flow Control. The Nexus® meter's RS232 communication does not support this feature.
- Instruct modem to write the new settings to activate profile. This places these settings into nonvolatile memory; the setting will take effect after the modem powers up.
- **When programming the remote modem with a terminal program, make sure the baud rate of the terminal program matches the Nexus® meter's baud rate**.

5.19: Selected Modem Strings

Modem	String/Setting
Cardinal modem:	AT&FE0F8&K0N0S37=9
Zoom/Faxmodem VFX V.32BIS(14.4K):	AT&F0&K0S0=1&W0&Y0
Zoom/Faxmodem 56Kx Dual Mode:	AT&F0&K0&C0S0=1&W0&Y0
USRobotics Sportster 33.6 Faxmodem:	AT&F0&N6&W0Y0 (for 9600 baud)
DIP switch setting:	Up Up Down Down Up Up Up Down
USRobotics Sportster 56K Faxmodem:	AT&F0&W0Y0
DIP switch setting:	Up Up Down Down Up Up Up Down

5.20: High Speed Inputs Connection

- The Nexus® 1250/1252 meter's built-in **High Speed Inputs** can be used in many ways:
  - ❖ Attach the KYZ HS Outputs from other meters for totalizing.
  - ❖ Attach relaying contacts for breaker status or initiated logging.
  - ❖ Set as an Input Trigger for Historical Log 2.
- Refer to the *Communicator EXT User Manual* for information on programming the functionality of these versatile inputs.
- The High Speed Inputs can be used with either dry or wet field contacts. For Wet contacts, the common rides on a unit-generated Nominal 15V DC. No user programming is necessary to use either wet or dry field contacts.

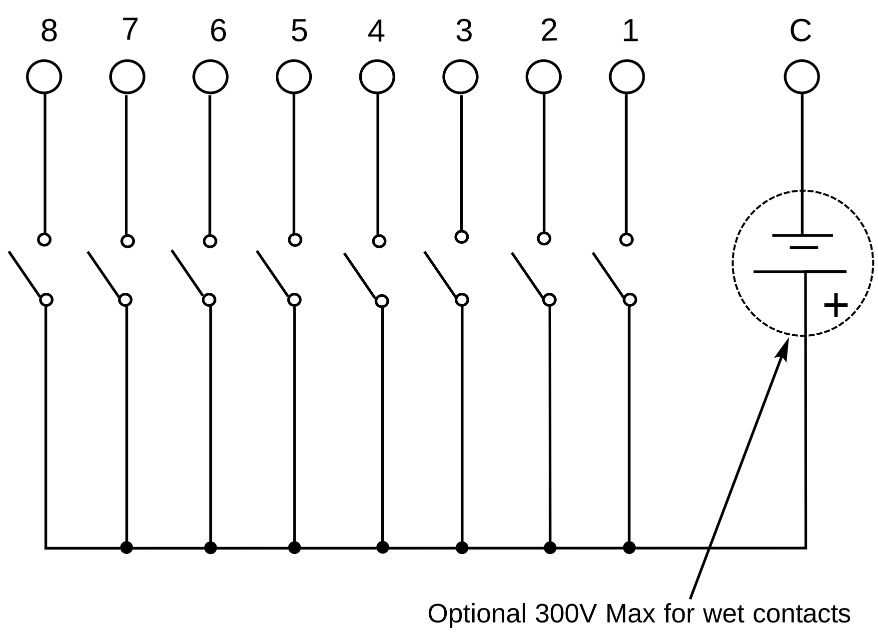


Figure 5.19: High Speed Inputs Connection

5.21: IRIG-B Connections

- **IRIG-B** is a standard time code format that synchronizes event timestamping to within 1 millisecond. An **IRIG-B** signal-generating device connected to the GPS satellite system will synchronize Nexus® 1250/1252 meters located at different geographic locations. Nexus® meters use an Unmodulated signal from a satelite-controlled clock (such as Arbiter 1093B). For details on installation, refer to the User’s Manual for the satellite-controlled clock in use. Below are installation steps and tips that will help you.

- Connect the (+) terminal of the Nexus® meter to the (+) terminal of the signal generating device; connect the (-) terminal of the Nexus® meter to the (-) terminal of the signal generating device.

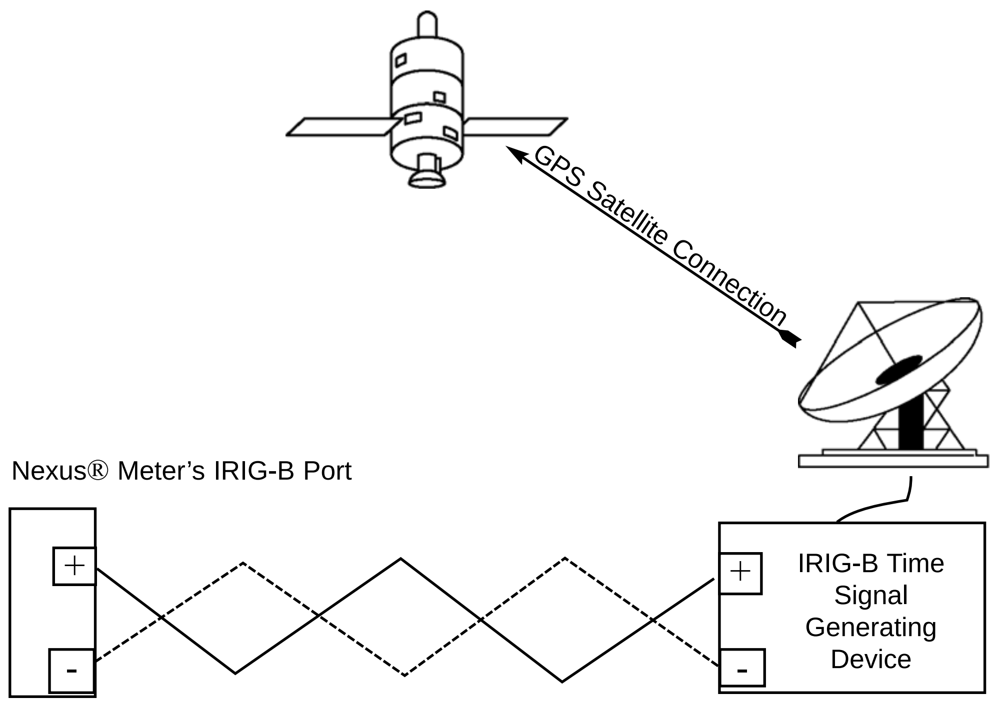


Figure 5.21: IRIG-B Connection

- **Installation:** Set Time Settings for the meter being installed.
  1. From the Communicator EXT **Device Profile** menu:
     a. Click **General Settings**>**Time Settings**>**one of the Time Settings lines**, to open the **Time Settings** screen.
     b. Set the Time Zone and Daylight Savings (Select **AutoDST** or **Enable** and set dates).
     c. Click **Update Device Profile** to save the new settings. (See Chapter 3 of the *Communicator EXT User’s Manual* for details.)
  2. Before connection, check that the date on the meter clock is correct (or, within 2 Months of the actual date). This provides the right year for the clock (GPS does not supply the Year).
  3. Connect the (+) terminal of the Nexus® meter to the (+) terminal of the signal generating device; connect the (-) terminal of the Nexus® meter to the (-) terminal of the signal generating device.

- **Troubleshooting Tip: The most common source of problems is a reversal of the two wires. If you have a problem, try reversing the wires.**

Chapter 6
Using the Nexus® Meter's External Displays

6.1: Overview

- Electro Industries offers four external displays for use with the Nexus® 1250/1252 meter. The **P40N**, **P41N,** and **P43N** are LED displays that provide easy-to-use access to the information stored in your Nexus® meter. The **P60N** is a Touch Screen display, which provides easy access to meter readings and information with a graphical touch screen presentation.

- Plug one of the Nexus® external displays into Port 3 or 4 of the meter, using the cable supplied with the display. The displays operate at 9600 baud. Port 3 is already factory-set to 9600 baud (see Chapter 5 for communication details). To use a display on another port, configure that port to operate at 9600 baud, using the Communicator EXT Software. See Chapter 3 of the *Communicator EXT User Manual* for instructions on configuring the meter's port.

6.2: Nexus® P40N, P41N and P43N LED External Displays

- The Nexus® P40N LED external display can be used alone or it can serve as the Master for a grouping of displays. The P40N prepares the data for the Slave displays: the P41N and the P43N. Once every second, it sends a request to the Nexus® meter. All necessary data for the Slave displays is returned to the Master display upon this request, and the Master sends the data to the Slaves in the proper format.

- The Nexus® P41N and P43N Slave displays listen to the Master, and display and update values on the screen when they receive proper data. These displays have no keypads. Data can only be received; it cannot be changed. If there is no data for more than 5 seconds, "Communication Lost" appears on the bottom of the screen. The following data is displayed when it is received:

    - **Amp Display (P41N): Amp A, Amp B, Amp C**
    - **Power Display (P43N): Watt, VAR, PF**

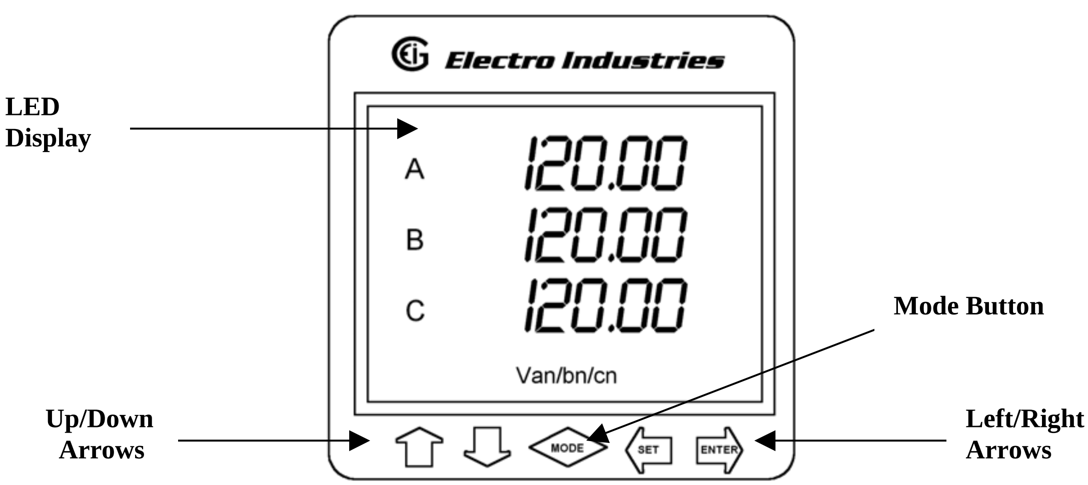


Figure 6.1: Nexus® P40N LED External Display

6.2.1: Connect Multiple Displays

- One cable (housing two-wire RS485 and two-wire power wires plus shield) is used to connect the displays. One port of the Nexus® meter supports 12 VA. Each P40N, P41N or P43N requires 3.3 VA (maximum 3.8 VA). The Master display (P40N) is the master in communication. The Amp, Power and Nexus® devices are slaves in communication. Therefore, the Master display (P40N) should be at the end of the daisy-chained units as shown in Figure 6.2.

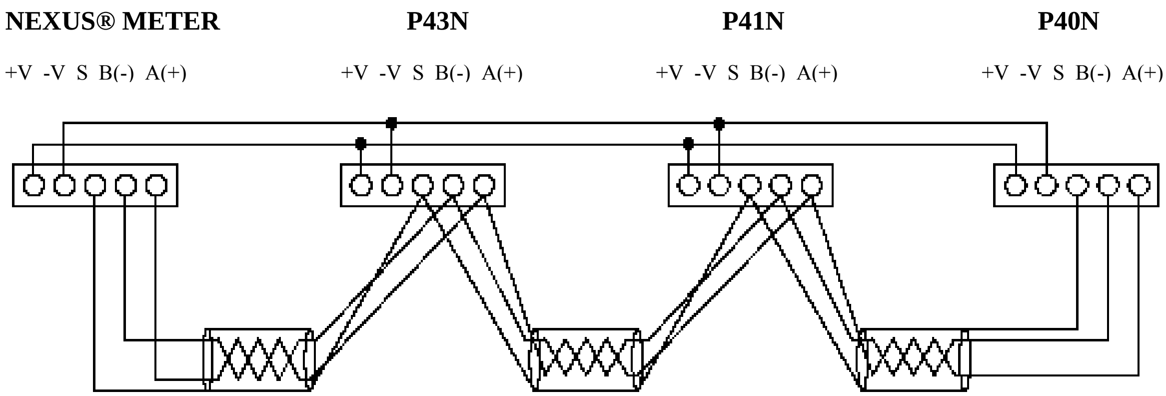


Figure 6.2: P40N Display Daisy Chain

NOTE: The power lines in figure 6.2 are shown separately, for clarity. All lines are actually on one cable.

- Figures 6.3 and 6.4 show the P41N and P43N displays showing sample readings.

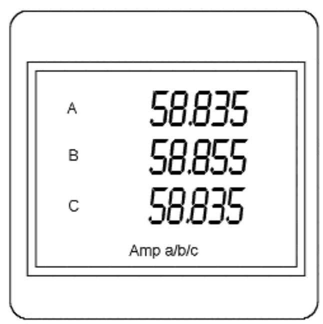


Figure 6.3: P41N Display

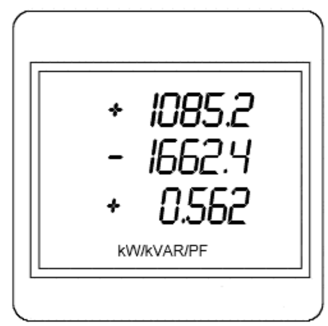


Figure 6.4: P43N Display

6.2.2: Nexus® P40N Display Modes

- The Nexus® P40N LED external display has three modes:
  - Dynamic Readings mode (sections 6.3 and 6.4)
  - Nexus® Information mode (sections 6.5 and 6.6)
  - Display Features mode (sections 6.7 and 6.8)
- Each mode is divided into groups. Most groups are further broken down into readings.
  - Use the **MODE** button to scroll between modes.
  - Use the **UP/DOWN** arrows to scroll from group to group within each mode.
  - Use the **LEFT/RIGHT** arrows to scroll from reading to reading within each group.
- Use the Communicator EXT software to Flash Update the P40N external display. Refer to the *Communicator EXT User Manual* for instructions.

6.3: Dynamic Readings Mode

- The External Display puts itself in the **Dynamic Readings Mode** upon power-up. Use the **Mode** button to access the Dynamic Readings from other Modes. Use the **Up/Down** arrows to navigate from Group to Group within this Mode. See Section 6.4 for a Navigation map of the Dynamic Readings Mode.

- **Group 1: Phase to Neutral Voltages** (Use the **Left/Right** arrows to access the following readings, in order.)

  - Volts AN/BN/CN
  - Maximum Volts AN/BN/CN
  - Minimum Volts AN/BN/CN
  - Volts AN/BN/CN %THD
  - Volts AN/BN/CN Maximum %THD
  - Volts AN/BN/CN Minimum %THD

- **Group 2: Phase to Phase Voltages** (Use the **Left/Right** arrows to access the following readings, in order.)

  - Volts AB/BC/CA
  - Maximum Volts AB/BC/CA
  - Minimum Volts AB/BC/CA

- **Group 3: Current** (Use the **Left/Right** arrows to access the following readings, in order.)

  - Current A/B/C
  - Maximum Current
  - Minimum Current
  - Current %THD
  - Current Maximum %THD
  - Current Minimum %THD
  - Current Calculated N/Measured N
  - Maximum Current Calculated N/Measured N

- **Group 4**: **Watt/VAR** (Use the **Left/Right** arrows to access the following readings, in order.)

  - kWatt/kVAR
  - Maximum +kWatt/+kVAR/CoIn kVAR
  - Maximum -kWatt/-kVAR/CoIn kVAR
  - Block (Fixed) Window Average Maximum +kWatt/+kVAR/CoIn kVAR
  - Predictive Rolling (Sliding) Window Maximum +kWatt/+kVAR/CoIn kVAR

- **Group 5:VA/PF/Frequency** (Use the **Left/Right** arrows to access the following readings, in order.)

  - kVA/PF lag/Hz
  - Maximum kVA/Hz
  - Minimum kVA/Hz

- Maximum Quadrant 1 Total PF
- Minimum Quadrant 1 Total PF
- Maximum Quadrant 2 Total PF
- Minimum Quadrant 2 Total PF
- Maximum Quadrant 3 Total PF
- Minimum Quadrant 3 Total PF
- Maximum Quadrant 4 Total PF
- Minimum Quadrant 4 Total PF

■ **Group 6: Delivered Energy** (Use the **Left/Right** arrows to access the following readings, in order.)

- +kWatthr Quadrant 1+Quadrant 4 (Primary)
- +kVAhr Quadrant 1 (Primary)
- +kVARhr Quadrant 1 (Primary)
- +kVAhr Quadrant 4 (Primary)
- -kVARhr Quadrant 4 (Primary)

■ **Group 7: Received Energy** (Use the **Left/Right** arrows to access the following readings, in order.)

- -kWatthr Quadrant 2+Quadrant 3 (Primary)
- +kVAhr Quadrant 2 (Primary)
- +kVARhr Quadrant 2 (Primary)
- +kVAhr Quadrant 3 (Primary)
- -kVARhr Quadrant 3 (Primary)

■ **Group 8: Accumulations** (Use the **Left/Right** arrows to access the following readings, in order.)

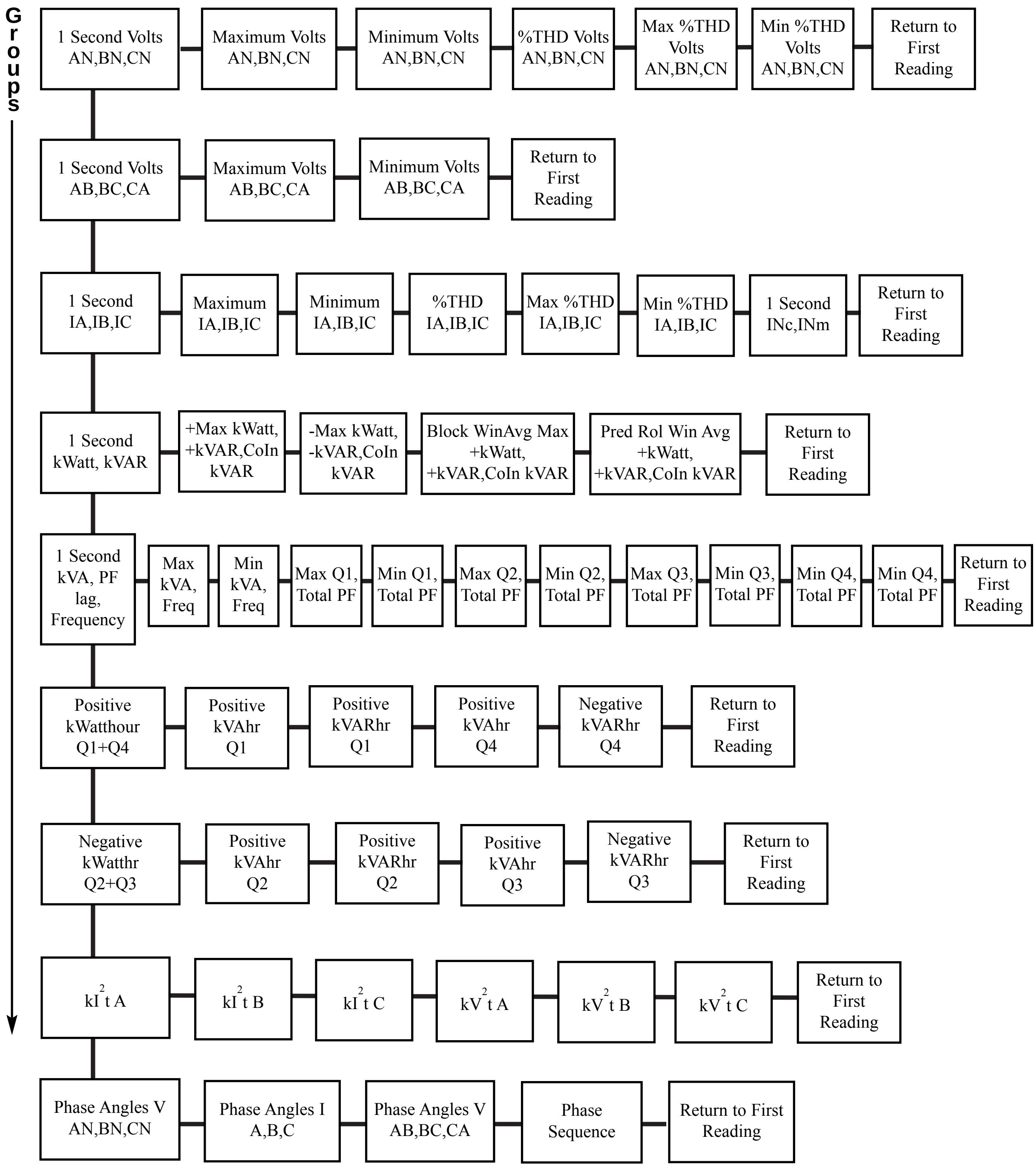
- kI^2t A
- kI^2t B
- kI^2t C
- kV^2t A
- kV^2t B
- kV^2t C

■ **Group 9: Phase Angles** (Use the **Left/Right** arrows to access the following readings, in order.)

- Phase Angle Van/bn/cn
- Phase Angle Ia/b/c
- Phase Angle Vab/bc/ca
- Phase Sequence

6.4: Navigation Map of Dynamic Readings Mode

- Use **Left/Right** arrow keys to navigate Readings
- Use **Up/Down** arrows to scroll between groups.



6.5: Nexus® Information Mode

- Use the **Mode** button to access the Nexus® **Information** mode from other modes. Use the **Up/Down** arrows to navigate from group to group within this mode. See Section 6.6 for a Navigation map of the Nexus® Information Mode.

- **Group 1: Device Time**

    - Meter Time

- **Group 2: Communication Settings** (Use the **Left/Right** arrows to access the following readings, in order.)

    - Communication Settings Port 1: Baud/Addr/Protocol
    - Communication Settings Port 2: Baud/Addr/Protocol
    - Communication Settings Port 3: Baud/Addr/Protocol
    - Communication Settings Port 4: Baud/Addr/Protocol

- **Group 3: PT, CT Ratios** (Use the **Left/Right** arrows to access the following readings, in order.)

    - PT Ratio
    - CT Ratio

- **Group 4: External Display Units**

    - Primary/Secondary

    - Select either **Primary** or **Secondary** units for the External Display using the Communicator EXT software (see the *Communicator EXT User Manual*).
        - When **Primary** is selected, the Display shows all readings in Primary units based on the user programmed PT and CT Ratios.
        - When **Secondary** is selected, the Display shows all readings in Secondary units.

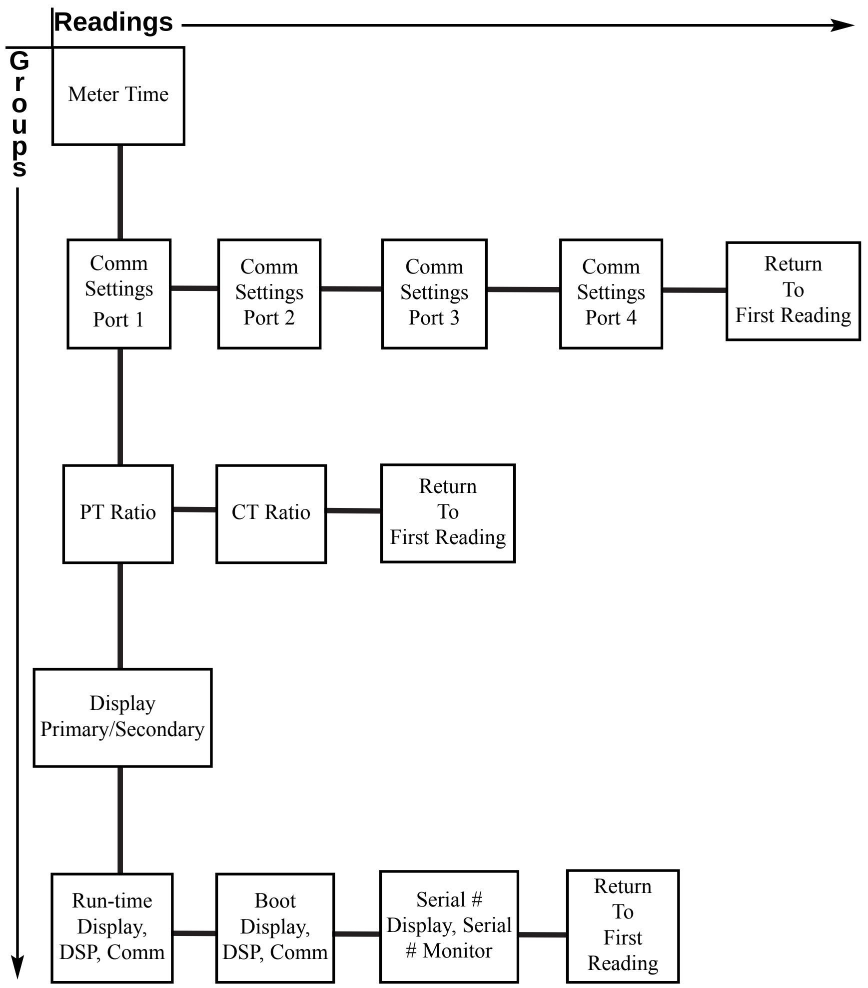
- **Group 5: Firmware Versions and Serial Numbers** (Use the **Left/Right** arrows to access the following readings, in order.)

    - Run Time External Display/Run Time DSP/RunTime Comm
    - Boot External Display/Boot DSP/Boot Comm
    - Serial Number External Display; Serial Number Nexus® Monitor

6.6: Navigation Map of Nexus® Information Mode

- Use **Up/Down** arrows to scroll between groups.

- Use **Left/Right** arrows to scroll between readings.



6.7: Display Features Mode

- Use the **Mode** button to access the **Display Features** Mode from other modes. Use the **Up/Down** arrows to navigate from group to group within this mode. See Section 6.8 for a Navigation map of the Display Features mode.

- **Group 1: Reset Max/Min**

  Press the **Enter** button to reset the Max and Min values.

NOTE: If the Password Protection feature has been enabled through Communicator EXT software, you will need to enter a password to reset the Max/Min readings. Follow this procedure:

1. Press the **Enter** button.
2. Enter the password, one character at a time, by pressing the **Up** or **Down** arrows. (Each password character begins as an “A”. Press the **Up** arrow to increment the character from “A–Z” and then from “0–9”. Press the **Down** arrow to decrement the character from “A” to “9–0” and then from “Z–A”.)
3. Press **Set** to enter each character in the password.
4. When the entire password is shown on the Display screen, press **Enter**.
5. Once the password is entered correctly, press **Enter** again to reset the Max/Min values.

- **Group 2: Reset Energy**

  Press the **Enter** button to reset the Energy readings.

  NOTE: If the Password Protection feature has been enabled through Communicator EXT software, you will need to enter a password to reset the E**nergy readings**. Follow steps 1-4, above. Then press **Enter** again to reset energy.

- **Group 3: Display Baud Rate/Address**

- **Group 4: Display Communication Protocol**

- **Group 5: EIG Use Only**

- **Group 6: EIG Use Only**

- **Group 7: Lamp Test**

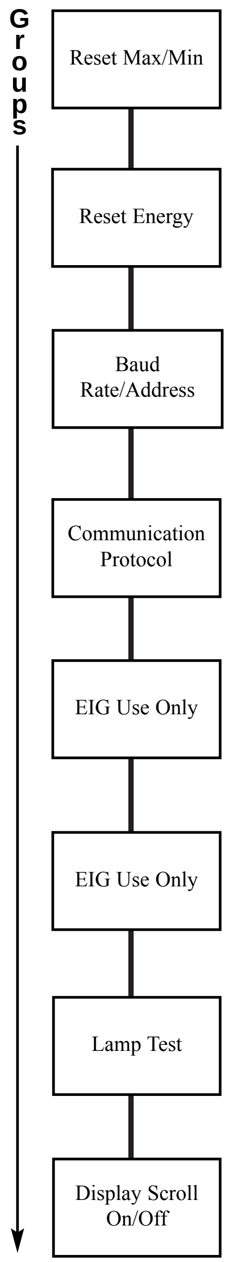
  - Press **Enter** to conduct an LED test.

- **Group 8: Display Scroll ON/OFF**

  - Press **Enter** to turn the scroll feature on or off. When the scroll feature is on, the P40N external display will scroll through the first reading of each group in the Dynamic Readings mode. If a button is pressed during the scroll, scrolling pauses for one minute.

6.8: Navigation Map of Display Features Mode

- Use **Up/Down** arrows to scroll between groups.



6.9: Nexus® P60N Touch Screen External Display

- The **P60N** Touch Screen external display is ready to use upon power-up. Touching the buttons at the top of the screen will take you to the groups of readings listed below. With the buttons at the bottom of the screen, you can use the touch screen to review Limits and review and/or change settings on the display and the Nexus® meter. Also, you can reset Max/Min and Demand, Hour, I2T and V2T Counters, all Logs and TOU for Current Session and Month using the **Reset** button.

  - All screens have a **Main** button that returns you to the **Main** screen, shown in the figure below. All screens also have a **Next** button that takes you to the next group of readings. Some of the screens have additional **Navigation** buttons to take you to related readings.

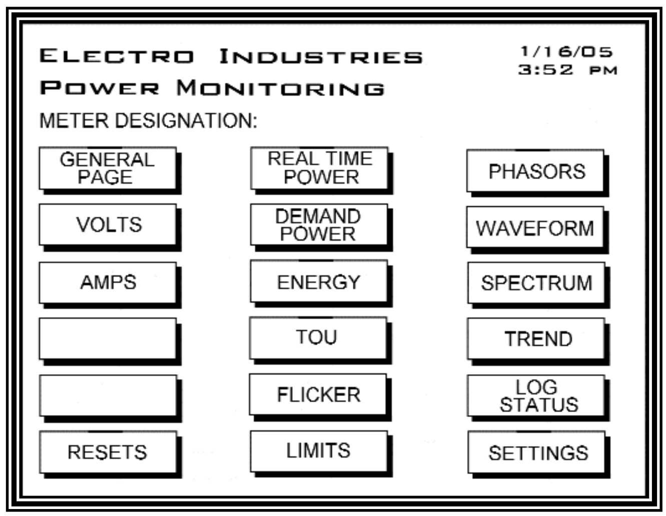
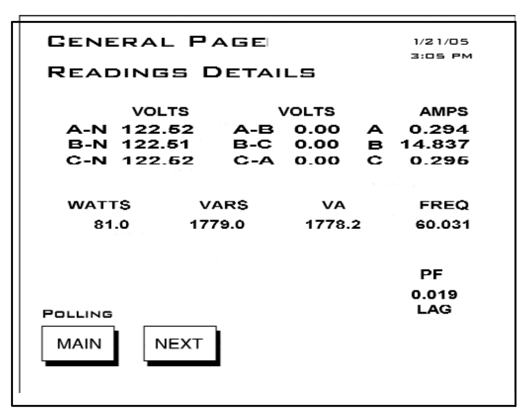


Figure 6.2: Nexus® P60N Touch Screen External Display Main Screen

- **GENERAL PAGE: Overview of Real Time Readings**

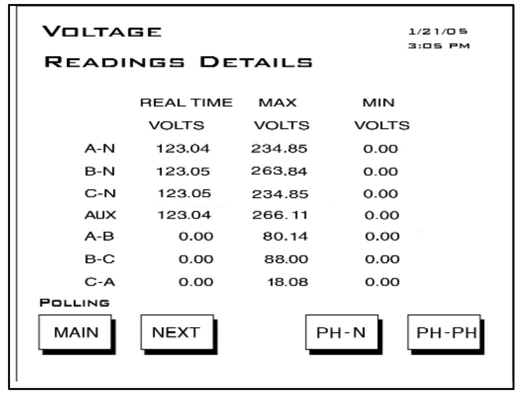
  - Volts AN/BN/CN/AB/BC/CA
  - Amps A/B/C
  - Watts
  - VARS
  - VA
  - FREQ
  - PF



■ **VOLTS: Voltage Readings Details**

- Real Time Volts AN/BN/CN/AB/BC/CA
- Maximum Volts AN/BN/CN/AB/BC/CA
- Minimum Volts AN/BN/CN/AB/BC/CA

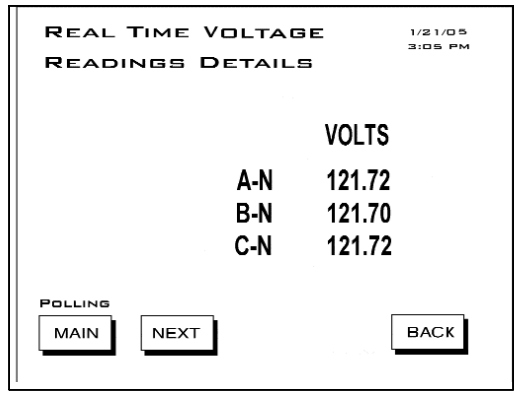
Touch **PH-N** or **PH-PH** to view details of Phase-to-Neutral or Phase-to-Phase Readings.



■ **VOLTS: Voltage Readings PH-N**

- Volts AN/BN/CN

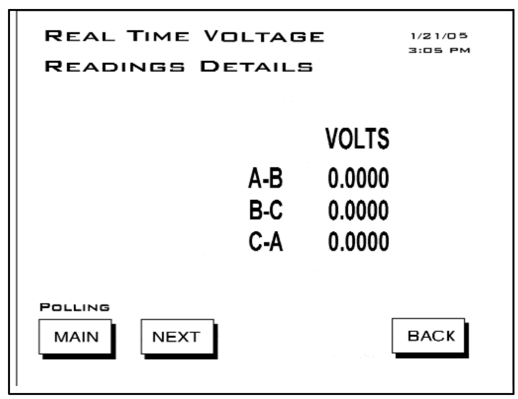
Touch **Back** to return to the **Volts** main screen.



■ **VOLTS: Voltage Readings PH-PH**

- Volts AB/BC/CA

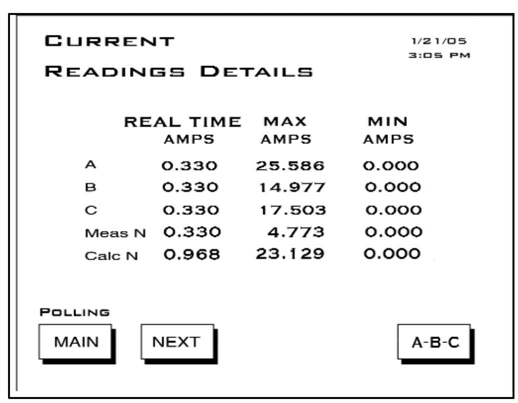
Touch **Back** to return to the **Volts** main screen.



■ **AMPS: Current Readings Details**

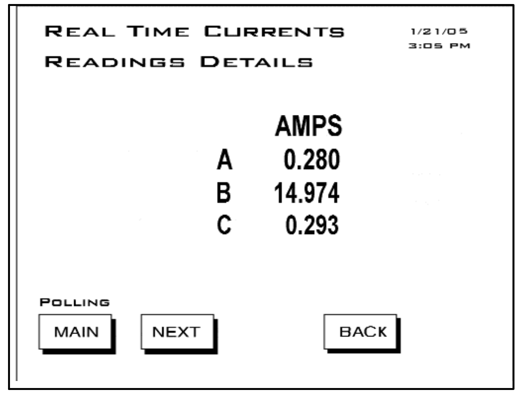
- Real Time Current A/B/C
- Maximum Current A/B/C
- Minimum Current A/B/C
- Current Calculated N/Measured N
- Maximum Current Calculated N/ Measured N

Touch **A-B-C** to view Currents Detail.



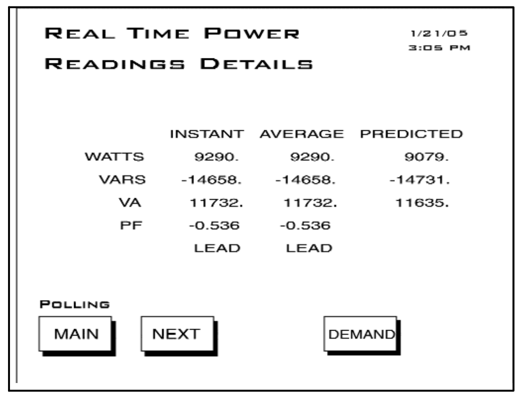
- **AMPS: Current Readings A-B-C**
  - Real Time Current A/B/C

Touch **Back** to view the **Amps** main screen.



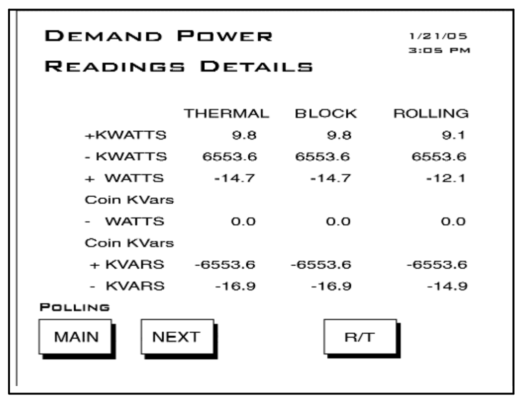
- **REAL TIME POWER: Real Time Power Readings Details**
  - Instant Watt/VAR/VA/PF
  - Average Watt/VAR/VA/PF
  - Predicted Watt/VAR/VA

Touch the **Demand** button to go to the **Demand Power** screen (shown below on the right)



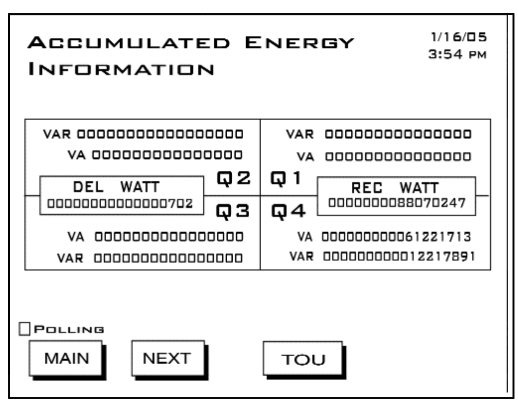
- **DEMAND POWER: Demand Power Readings Details**
  - Thermal Window Average Maximum +kWatt/+kVAR/CoIn kVAR
  - Block (Fixed) Window Average Maximum +kWatt/+kVAR/CoIn kVAR
  - Predictive Rolling (Sliding) Window Maximum +kWatt/+kVAR/CoIn kVAR

Touch **R/T** button to view **Real Time Power** screen.



- **ENERGY: Accumulated Energy Information**
  - -Watthr Quadrant 2+Quadrant 3 (Primary)
  - +VAhr Quadrant 2 (Primary)
  - +VARhr Quadrant 2 (Primary)
  - +VAhr Quadrant 3 (Primary)
  - -VARhr Quadrant 3 (Primary)
  - +Watthr Quadrant 1+Quadrant 4 (Primary)
  - +VAhr for all Quadrants (Primary)

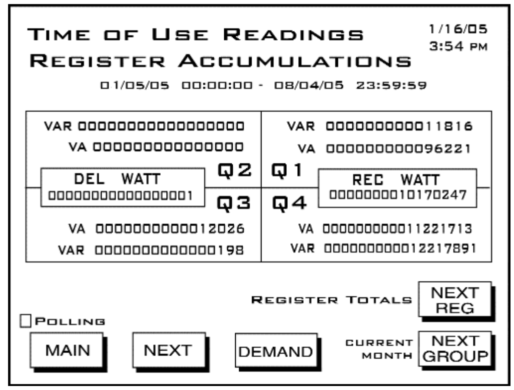
Touch **TOU** button to view **TOU Register Accumulations** screen.



■ TOU: Accumulations

- -Watthr Quadrant 2+Quadrant 3 (Primary)
- +VAhr Quadrant 2 (Primary)
- +VARhr Quadrant 2 (Primary)
- +VAhr Quadrant 3 (Primary)
- -VARhr Quadrant 3 (Primary)
- +Watthr Quadrant 1+Quadrant 4 (Primary)
- +VAhr Quadrants 1 & 4 (Primary)
- -VARhr Quadrant 4 (Primary)

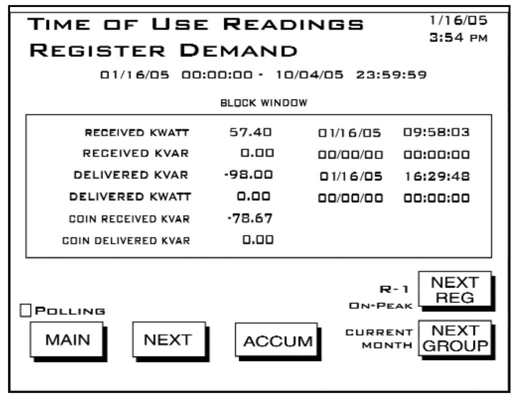
Touch **Demand** to view **Register Demand** screen.
Touch **Next Reg** to scroll Registers 1 - 8 and Totals.
Touch **Next Group** to scroll Prior Season, Prior Month, Current Season, and Current Month.



■ TOU: Register Demand

- Block (Fixed) Window +kWatth, +kVARhr, -kWatth, -kVARh, Coin +kVARh, Coin -kVARh

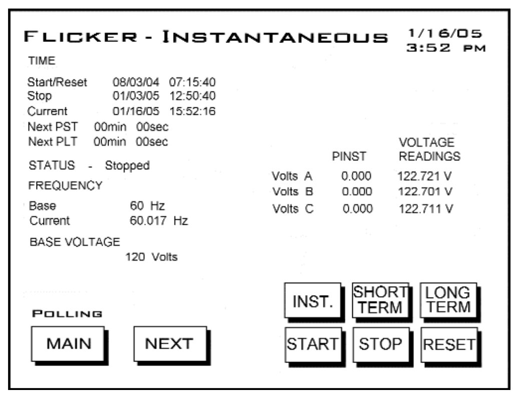
Touch **Accum** to view TOU Accumulations.
Touch **Next Reg** to scroll Registers 1 - 8 and Totals.
Touch **Next Group** to scroll Prior Season, Prior Month, Current Season, and Current Month.



■ FLICKER - INSTANTANEOUS

Time Start/Reset, Stop, Current, Next PST, PLT
Status (Active or Stopped)
Frequency
Base Voltage
Frequency

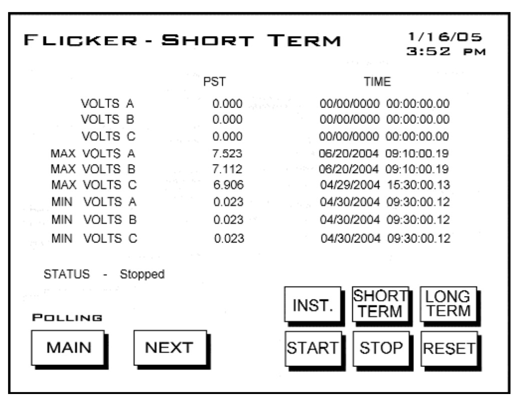
Touch **Short Term** or **Long Term** to view other **Flicker** screens.
NOTE: The **Start** button displays if Status is "Stopped"; the **Stop** button displays if Status is "Active."



■ FLICKER - SHORT TERM

- Volts A/B/C
- Max Volts A/B/C
- Min Volts A/B/C

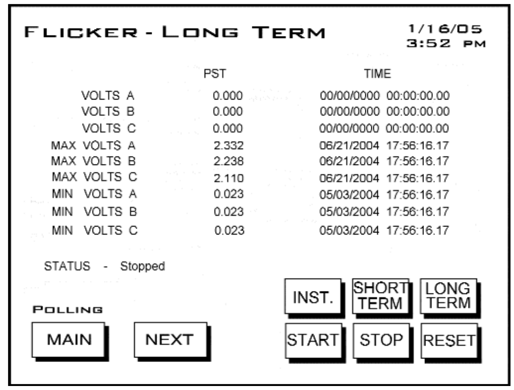
Touch **Inst** or **Long Term** to view screens.
NOTE: The **Start** button displays if Status is "Stopped"; the **Stop** button displays if Status is "Active."



■ FLICKER - LONG TERM

- Volts A/B/C
- Max Volts A/B/C
- Min Volts A/B/C

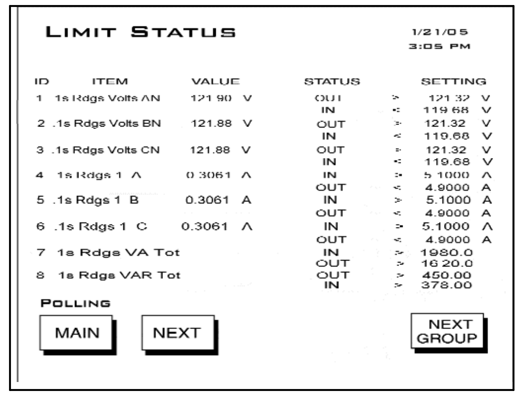
Touch **Inst** or **Long Term** to view other **Flicker** screens.
NOTE: The **Start** button displays if Status is "Stopped"; the **Stop** button displays if Status is "Active."



■ LIMITS: Limit Status

Current Limits Settings for the meters, ID 1 - 32. For each ID number, the Type of Reading, Value, Status (In or Out of Limit) and Setting is shown. The first screen displays the settings for Meters ID 1 to 8.

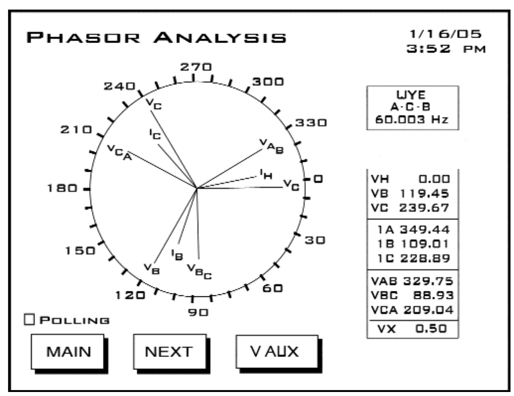
Touch **Next Group** to scroll to the next screen, which displays the settings for Meters ID 9 to 16. Touch **Next Group** again to view settings for Meters ID 17 to 24 and 25 to 32.



■ PHASORS: Phasor Analysis

Phase Angles for Form shown at top of the screen.

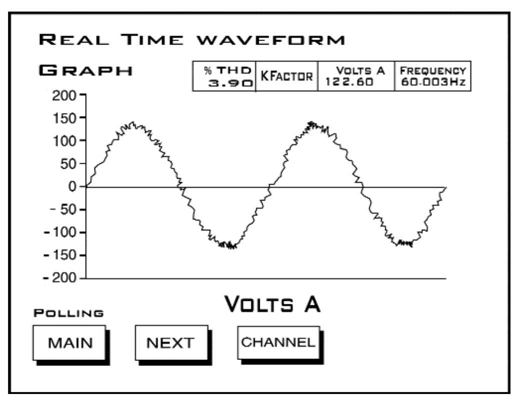
- Phase
- Phase Angle Van/bn/cn
- Phase Angle Ia/b/c
- Phase Angle Vab/bc/ca



■ WAVEFORM: Real Time Graph

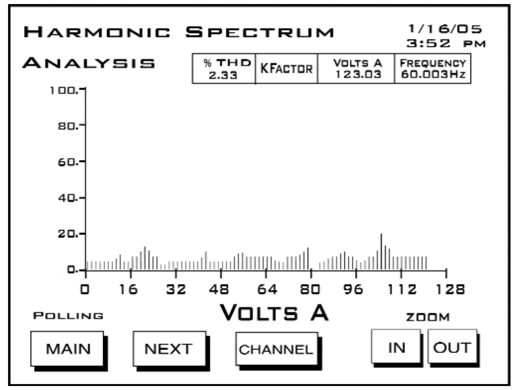
- Channel Va/b/c
- Channel Ia/b/c
- % THD, KFactor, Frequency for selected channel

Touch **Channel** button to view scroll through channels.



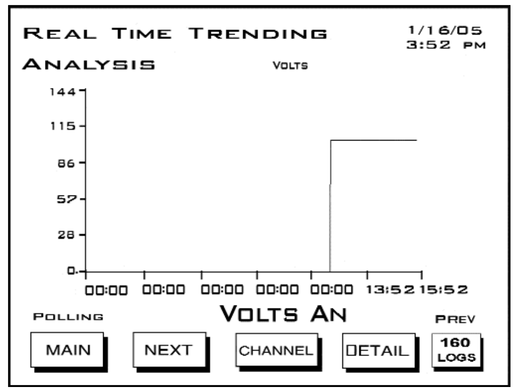
- **SPECTRUM: Harmonic Spectrum Analysis**
  Select a Channel by touching the **Channel** button. Graphs and readings appear for the selected channel.

  Zoom In or Out for detail by touching **In** or **Out**.



- **REAL TIME TRENDING ANALYSIS**
  Select a Channel by touching the **Channel** button. The Channel Selector screen (shown below, on the right) appears.
  Select a Channel and touch **OK** to return to this screen. Trending for the Selected Channel will begin on this screen.

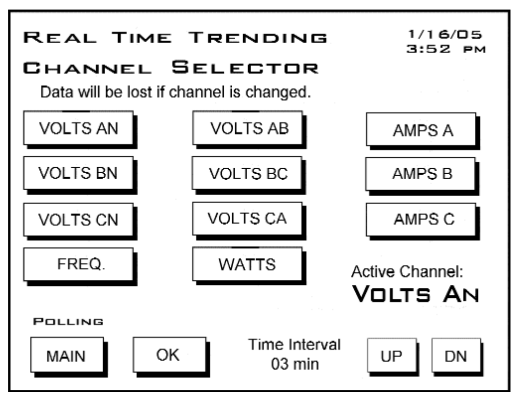
  To see a Detail of logs for the Selected Channel, touch the **Detail** Button. A Table of Logs for the Selected Channel appears (Volts AN shown at bottom right).
  Touch **Previous Logs** to view other logs.



- **REAL TIME TRENDING CHANNEL SELECTOR:**
  Select Channel by touching a Channel button. The Active Channel appears at the lower right of the display.
  NOTE: Data from the previously Active Channel is lost if the Channel is changed.

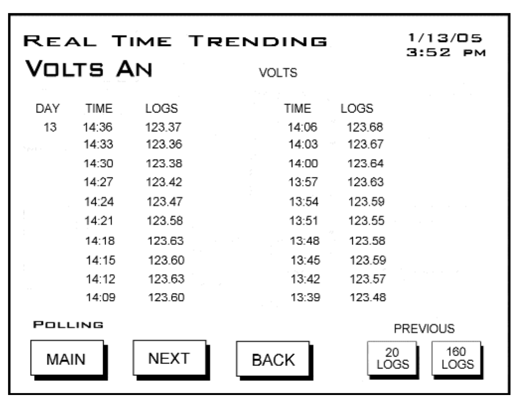
  The Time Interval for Trending appears at the bottom of the screen. To increase the Interval, touch the **Up** button. To decrease the Interval, touch the **Dn** (Down) button.

  Touch **OK** to return to the Trending Analysis screen.



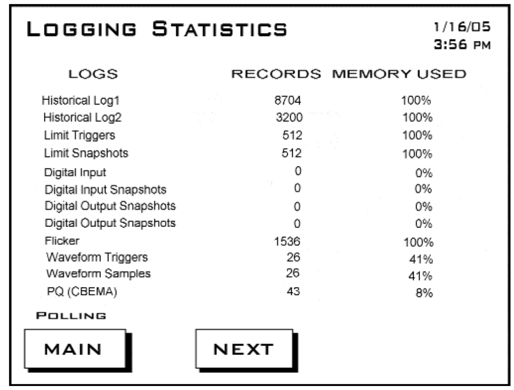
- **REAL TIME TRENDING DETAIL**
  A Table of Logs for the Selected Channel (Volts AN is shown here)

  Touch **Back** to return to the Trending Analysis screen.
  Touch **Previous Logs** to view other logs.



■ **LOG STATUS: Logging Statistics**
An Overview of the Logs for the Primary Meter.

The Number of Records and Memory Used are listed for each log.

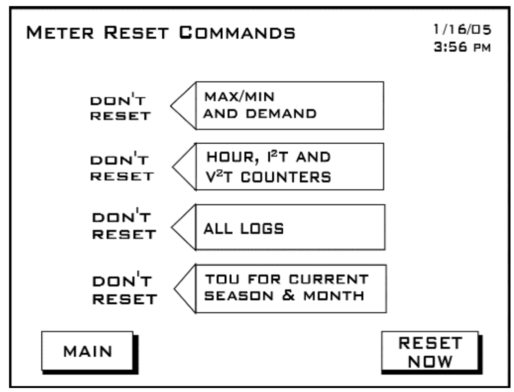


■ **RESET: Meter Reset Commands**

WARNING! Resets cause data to be lost.

Touch the window for the Reset you want to perform.
Don't Reset changes to **Reset.**
Touch the **Reset Now** button. **OK** will appear.
Touch **OK** to refresh the screen (view the original screen).

- Max/Min and Demand
- Hour, I2T and V2T Counters
- All Logs
- TOU for Current Session and Month

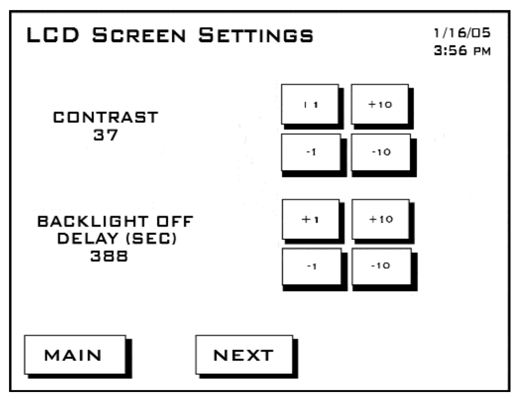


■ **SETTINGS:**

■ **LCD SCREEN SETTINGS**

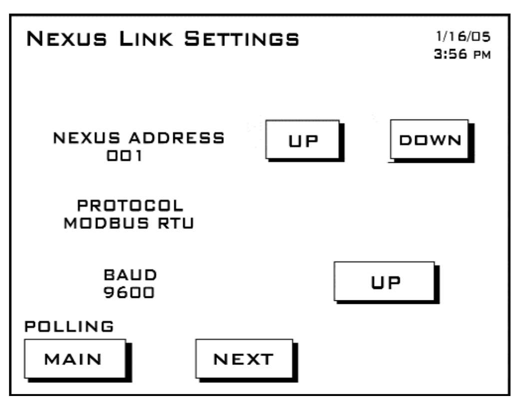
Contrast: Touch **Up/Down** buttons to increase/decrease settings.
NOTE: Number 37 is the optimum setting.

Backlight Off Delay: the number of seconds after use that the backlight turns off.
Touch **Up/Down** buttons to increase/decrease settings.

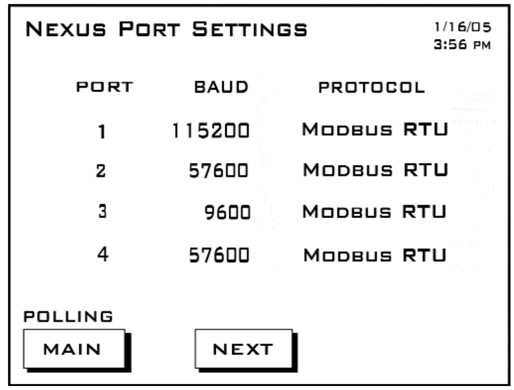


■ **NEXUS® LINK SETTINGS**

Nexus® Meter's Address (000 - 255).
Touch **Up/Down** buttons to increase/decrease settings.
Protocol (selected)
Baud (selected)

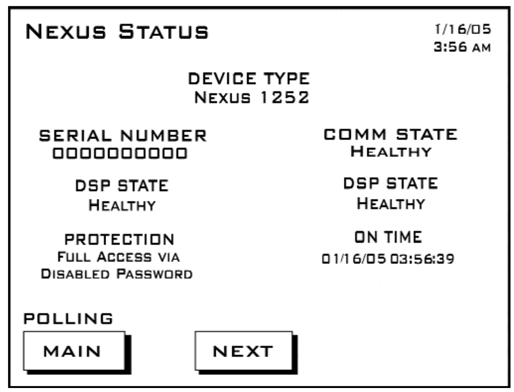


■ NEXUS® PORT SETTINGS



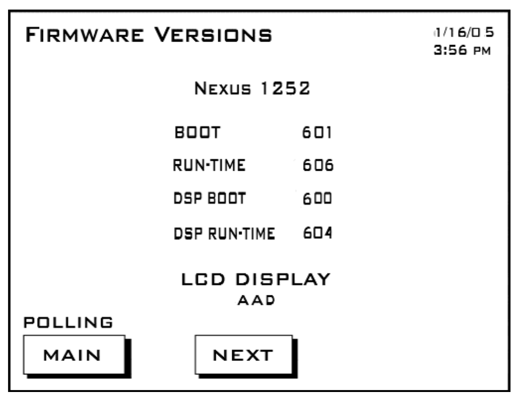
- Port 1 (Baud and Protocol selected)
- Port 2 (Baud and Protocol selected)
- Port 3 (Baud and Protocol selected)
- Port 4 (Baud and Protocol selected)

■ NEXUS® METER STATUS



Device Type: Nexus® 1250/1252 Meter
Serial Number (10 digit number)
Comm State: Healthy or Unhealthy
Nv Ram: 4 MB
DSP State: Healthy or Unhealthy
Protection: Password Enabled or Disabled
On Time: Current Date and Time

■ FIRMWARE VERSIONS



This screen displays the current firmware version for the Nexus® meter and the display.

Nexus® 1250/1252 Meter
Boot: 601
Run-time: 606
DSP Boot: 600
DSP Run-time: 604
LCD Display: AAD

Chapter 7
Transformer Loss Compensation

7.1: Introduction

- The Edison Electric Institute's Handbook for Electricity Metering, Ninth Edition defines Loss Compensation as:

  A means for correcting the reading of a meter when the metering point and point of service are physically separated, resulting in measurable losses including I^2R losses in conductors and transformers and iron-core losses. These losses may be added to or subtracted from the meter registration.

- Loss compensation may be used in any instance where the physical location of the meter does not match the electrical location where change of ownership occurs. Most often this appears when meters are connected on the low voltage side of power transformers when the actual ownership change occurs on the high side of the transformer. This condition is shown pictorially in Figure 7.1.

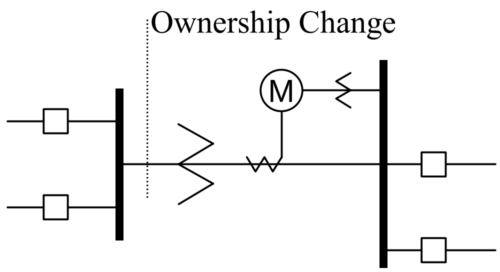


Figure 7.1: Low Voltage Metering Installation Requiring Loss Compensation

- It is generally less expensive to install metering equipment on the low voltage side of a transformer and in some conditions other limitations may also impose the requirement of low-side metering even though the actual ownership change occurs on the high-voltage side.

- The need for loss compensated metering may also exist when the ownership changes several miles along a transmission line where it is simply impractical to install metering equipment. Ownership may change at the midway point of a transmission line where there are no substation facilities. In this case, power metering must again be compensated. This condition is shown in Figure 7.2.

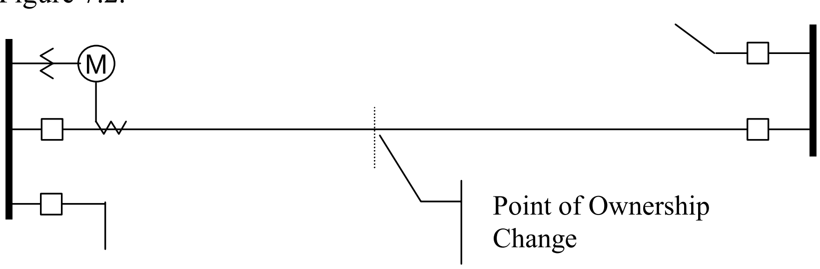


Figure 7.2: Joint Ownership Line Metering Requiring Loss Compensation

- A single meter cannot measure the losses in a transformer or transmission line directly. It can, however, include computational corrections to calculate the losses and add or subtract those losses to the power flow measured at the meter location. This is the method used for loss compensation in the Nexus® meter. Refer to Appendix B of the *Communicator EXT User Manual* for detailed explanation and instructions for using the Transformer Line Loss Compensation feature of the Nexus® 1250/1252 meter.

- The computational corrections used for transformer and transmission line loss compensation are similar. In both cases, no-load losses and full-load losses are evaluated and a correction factor for each loss level is calculated. However, the calculation of the correction factors that must be programmed into the meter differ for the two different applications. For this reason, the two methodologies will be treated separately in this chapter.

- In the Nexus® meter, Loss Compensation is a technique that computationally accounts for active and reactive power losses. The meter calculations are based on the formulas below. These equations describe the amount of active (Watts) and reactive (VARs) power lost due to both iron and copper effects (reflected to the secondary of the instrument transformers).

  Total Secondary Watt Loss =
  (((Measured Voltage/Cal point Voltage)^2 x %LWFE) + ((Measured Current/Cal Point Current)^2 x %LWCU)) x Full-scale Secondary VA

  Total Secondary VAR Loss =
  (((Measured Voltage/Cal point Voltage)^4 x %LVFE) + ((Measured Current/Cal Point Current)^2 x %LVCU)) x Full-scale Secondary VA

- The Values for %LWFE, %LWCU, %LVFE, and %LVCU are derived from the transformer and meter information, as demonstrated in the following sections.

- The calculated loss compensation values are added to or subtracted from the measured Watts and VARs. The selection of adding or subtracting losses is made through the meter’s profile when programming the meter (see the following section for instructions). The meter uses the combination of the add/subtract setting and the directional definition of power flow (also in the profile) to determine how to handle the losses. Losses will be "added to" or "subtracted from" (depending on whether add or subtract is selected) the Received Power flow. For example, if losses are set to "Add to" and received power equals 2000 kW and losses are equal to 20kW then the total metered value with loss compensation would be 2020 kW; for these same settings if the meter measured 2000 kW of delivered power the total metered value with loss compensation would be 1980 kW.

- Since transformer loss compensation is the more common loss compensation method, the meter has been designed for this application. Line loss compensation is calculated in the meter using the same terms but the percent values are calculated by a different methodology.

- Nexus® Meter Transformer Loss Compensation:
  - Performs calculations on each phase of the meter for every measurement taken. Unbalanced loads are accurately handled.
  - Calculates numerically, eliminating the environmental effects that cause inaccuracies in electromechanical compensators.
  - Performs Bidirectional Loss Compensation.

- Requires no additional wiring; the compensation occurs internally.
- Imposes no additional electrical burden when performing Loss Compensation.

■ Loss Compensation is applied to 1 second per phase Watt/VAR readings and, because of that, affects all subsequent readings based on 1 second per phase Watt/VAR readings. This method results in loss compensation being applied to the following quantities:
- Total Power
- Demands, per phase and Total (Thermal, Block (Fixed) Window, Rolling (Sliding) Window and Predictive Window)
- Maximum and Minimum Demands
- Energy Accumulations
- KYZ Output of Energy Accumulations

NOTE: Loss Compensation is disabled when the meter is placed in Test Mode.

7.2: Nexus® 1250/1252 Meter's Transformer Loss Compensation

■ The Nexus® meter provides compensation for active and reactive power quantities by performing numerical calculations. The factors used in these calculations are derived either:
- By clicking the TLC Calculator button on the Transformer Loss screen of the Device Profile, to open the EIG Loss Compensation Calculator in Microsoft Excel
- By figuring the values from the worksheet shown here and in Appendix B of the *Communicator EXT User Manual*.

Either way, the derived values are entered into the Communicator EXT software through the Device Profile Transformer and Line Loss Compensation screen.

■ The Communicator EXT software allows you to enable Transformer Loss Compensation for Losses due to Copper and Iron, individually or simultaneously. Losses can either be added to or subtracted from measured readings. Refer to Appendix B in the *Communicator EXT User Manual* for instructions.

■ Loss compensation values must be calculated based on the meter installation. As a result, transformer loss values must be normalized to the meter by converting the base voltage and current and taking into account the number of elements used in the metering installation. For three-element meters, the installation must be normalized to the phase-to-neutral voltage and the phase current; in two-element meters the installation must be normalized to the phase-to-phase voltage and the phase current. This process is described in the following sections.

7.2.1: Loss Compensation in Three Element Installations

- Loss compensation is based on the loss and impedance values provided on the transformer manufacturer's test report. A typical test report will include at least the following information:
  - Manufacturer
  - Unit Serial Number
  - Transformer MVA Rating (Self-Cooled)
  - Test Voltage
  - No Load Loss Watts
  - Load Loss Watts (or Full Load Loss Watts)
  - % Exciting Current @ 100% voltage
  - % Impedance

- The transformer MVA rating is generally the lowest MVA rating (the self-cooled or OA rating) of the transformer winding. The test voltage is generally the nominal voltage of the secondary or low voltage winding. For three-phase transformers these values will typically be the three-phase rating and the phase-to-phase voltage. All of the test measurements are based on these two numbers. Part of the process of calculating the loss compensation percentages is converting the transformer loss values based on the transformer ratings to the base used by the meter.

- Correct calculation of loss compensation also requires knowledge of the meter installation. In order to calculate the loss compensation settings you will need the following information regarding the meter and the installation:
  - Number of meter elements
  - Potential Transformer Ratio (PTR)
  - Current Transformer Ratio (CTR)
  - Meter Base Voltage
  - Meter Base Current

- This section is limited to application of Nexus® meters to three-element metering installations. As a result, we know that:

  - Number of metering elements = 3
  - Meter Base Voltage = 120 Volts
  - Meter Base Current = 5 amps

7.2.1.1: Three-Element Loss Compensation Worksheet

Company		Station Name	
Date		Trf. Bank No.	
Trf Manf		Trf Serial No.	
Calculation by			

- **Transformer Data (from Transformer Manufacturer's Test Sheet)**

Winding	Voltage	MVA	Connection
HV – High			Δ-Y
Xv – Low			Δ-Y
YV – Tertiary			Δ-Y

Value	Watts Loss		
	3-Phase	1-Phase	1-Phase kW
No-Load Loss			
Load Loss			

Enter 3-Phase or 1-Phase values. If 3-Phase values are entered, calculate 1-Phase values by dividing 3-Phase values by three. Convert 1-Phase Loss Watts to 1-Phase kW by dividing 1-Phase Loss Watts by 1000.

Value	3-Phase MVA	1-Phase MVA	1-Phase kVA
Self-Cooled Rating			

Enter 3-Phase or 1-Phase values. If 3-Phase values are entered, calculate 1-Phase values by dividing 3-Phase values by three. Convert 1-Phase Self-Cooled MVA to 1-Phase kVA by multiplying by 1000.

% Exciting Current	
% Impedance	

Value	Phase-to-Phase	Phase-to-Neutral
Test Voltage (volts)		
Full Load Current (Amps)		

Test Voltage is generally Phase-to-Phase for three-phase transformers. Calculate Phase-to-Neutral Voltage by dividing Phase-to-Phase Voltage by $\sqrt{3}$. Calculate Full Load Current by dividing the (1-Phase kW Self-Cooled Rating) by the (Phase-to-Neutral Voltage) and multiplying by 1000.

■ Meter/Installation Data

Instrument Transformers	Numerator	Denominator	Multiplier
Potential Transformers			
Current Transformers			
Power Multiplier [(Pt Multiplier) times (CT Multiplier)]			

Enter the Numerator and Denominator for each instrument transformer. For example, a PT with a ratio of 7200/120 has a numerator or 7200, a denominator or 120 and a multiplier of 60 (7200/120 = 60/1).

Meter Secondary Voltage (volts)	120
Meter Secondary Current (Amps)	5

■ Base Conversion Factors

Quantity	Transformer	Multiplier	Trf IT Sec	Meter Base	Meter/Trf
Voltage				120	
Current				5	

For Transformer Voltage, enter the Phase-to-Neutral value of Test Voltage previously calculated. For Transformer Current, enter the Full-Load Current previously calculated. For Multipliers, enter the PT and CT multipliers previously calculated.
TrfIT Secondary is the Base Value of Voltage and Current at the Instrument Transformer Secondary of the Power Transformer. These numbers are obtained by dividing the Transformer Voltage and Current by their respective Multipliers. The Meter/Trf values for Voltage and Current are obtained by dividing the Meter Base values by the TrfIT Secondary values.

■ Load Loss at Transformer

No-Load Loss Watts (kW) = 1-Phase kW No-Load Loss = _______________

No-Load Loss VA (kVA) = (%Exciting Current) * (1-Phase kVA Self-Cooled Rating) / 100
= (_______________) * (_________________) / 100

= ________________ kVA

No-Load Loss VAR (kVAR) = SQRT((No-Load Loss kVA)^2 - (No-Load Loss kW)^2)

= SQRT((__________________)^2 - (_________________)^2)

= SQRT((___________________) - (___________________))

= SQRT (__________________)

= _____________________

Full-Load Loss Watts (kW) = 1-Phase Kw Load Loss = _______________

Full-Load Loss VA (kVA) = (%Impedance) * (1-Phase kVA Self-Cooled Rating) / 100

= (______________) * (________________) / 100

= _______________ kVA

Full-Load Loss VAR (kVAR) = SQRT((Full-Load Loss kVA)2 - (Full-Load Loss kW)2)

= SQRT((_________________)2 - (________________)2)

= SQRT((__________________) - (_________________))

= SQRT (_________________)

= _________________

- **Normalize Losses to Meter Base**

Quantity	Value at Trf Base	M/T Factor	M/T Factor Value	Exp	M/T Factor w/Exp	Value at Meter Base
No-Load Loss kW		V		^2		
No-Load Loss kVAR		V		^4		
Load Loss kW		1		^2		
Load Loss kVAR		1		^2		

Enter Value at Transformer Base for each quantity from calculations above. Enter Meter/Trf Factor value from Base Conversion Factor calculations above. Calculate M/T Factor with Exponent by raising the M/T Factor to the power indicated in the "Exp" (or Exponent) column. Calculate the "Value at Meter Base" by multiplying the (M/T Factor w/ Exp) times the (Value at Trf Base).

- **Loss Watts Percentage Values**

Meter Base kVA = 600 * (PT Multiplier) * (CT Multiplier) / 1000

= 600 * (____________) * (___________) / 1000

= ________________

- **Calculate Load Loss Values**

Quantity	Value at Meter Base	Meter Base kVA	% Loss at Meter Base	Quantity
No-Load Loss kW				% Loss Watts FE
No-Load Loss kVAR				% Loss VARs FE
Load Loss kW				% Loss Watts CU
Load Loss kVAR				% Loss VARs CU

Enter "Value at Meter Base" from Normalize Losses section. Enter "Meter Base kVA" from previous calculation. Calculate "% Loss at Meter Base" by dividing (Value at Meter Base) by (Meter Base kVA) and multiplying by 100.

Enter calculated % Loss Watts values into the Nexus® meter using Communicator EXT software. Refer to Appendix B of the *Communicator EXT User Manual* for instructions.

Chapter 8
Time-of-Use Function

8.1: Introduction

- A **Time-of-Use** (**TOU**) usage structure takes into account the quantity of energy used and the time at which it was consumed. The Nexus® 1250/1252 meter's TOU function, available with the **Communicator EXT** software, is designed to accommodate a variety of programmable rate structures. The Nexus® meter's TOU function accumulates data based on the time-scheme programmed into the meter.

- See Chapter 10 of the *Communicator EXT User Manual* for details on programming the Nexus® 1250/1252 meter's 20-year TOU calendar and retrieving TOU data.

8.2: The Nexus® Meter's TOU Calendar

- A Nexus® TOU calendar sets the parameters for TOU data accumulation. You may store up to twenty calendars in the Nexus® 1250/1252 meter and an unlimited amount of calendar files on your computer.

- The Nexus® TOU calendar profile allows you to assign a programmable usage schedule – e.g., "Weekday," "Weekend," or "Holiday"- to each day of the calendar year. You may create up to 16 different TOU schedules.

- Each TOU schedule divides the 24-hour day into fifteen-minute intervals from 00:00:00 to 23:59:59. You may apply one of eight different programmable registers - e.g., "Peak," "Off Peak," or "Shoulder Peak," to each fifteen-minute interval.

- The Nexus® 1250/1252 meter stores:

    - Accumulations on a seasonal basis, up to four seasons per year;
    - Accumulations on a monthly basis.

- Seasonal and monthly accumulations may span from one year into the next. Each season and month is defined by a programmable start/billing date, which is also the end-date of the prior season or month.

    - A season ends at midnight of the day before the start of the next season.
    - A month ends at midnight of the month's billing day.

- **If the year ends and there is no new calendar, TOU accumulations stop**. The last accumulation for the year will end on 12:31:23:59:59.
  If a calendar is present for the following year, TOU accumulations continue until the next monthly bill date or next start-of-season is reached. Accumulation can span into the following year.

8.3: TOU Prior Season and Month

- The Nexus® 1250/1252 meter stores accumulations for the prior season and the prior month. When the end of a billing period is reached, the current season or month becomes stored as the prior. The registers are then cleared and accumulations resume, using the next set of TOU schedules and register assignments from the stored calendar.

- Prior and current accumulations to date are always available.

8.4: Updating, Retrieving and Replacing TOU Calendars

- Communicator EXT software retrieves TOU calendars from the Nexus® meter or from the computer's hard drive for review and edit.

- Up to a maximum of twenty yearly calendars can be stored in the Nexus® meter at any given time. You may retrieve them one at a time; a new calendar can be stored while a current calendar is in use.

- Accumulations do not stop during calendar updates. If a calendar is replaced while in use, the accumulations for the current period will continue until the set end date. At that point, the current time will become the new start time and the settings of the new calendar will be used.

- Reset the current accumulations, if you replace a calendar in use. A reset clears only the current accumulation registers. This causes the current accumulations to use the present date as the start and accumulate to the next new end date, which will be taken from the new calendar. Once stored, prior accumulations are always available and cannot be reset. See Chapter 3 of the *Communicator EXT User Manual* for instructions on resetting TOU accumulations.

- At the end of a defined period, current accumulations are stored, the registers are cleared and accumulations for the next period begin. When the year boundary is crossed, the second calendar, if present, is used. To retain continuity, you have up to one year to replace the old calendar with one for the following year.

8.5: Daylight Savings and Demand

- To enable Daylight Savings Time for the meter: from the Device Profile menu click **General Settings>Time Settings.** In the **Time Settings** screen, click **Auto DST**, which sets Daylight Savings Time automatically (**for the United States only**). You can also select **User Defined** and enter the desired dates for Daylight Savings Time. See Chapter 3 of the *Communicator EXT User Manual* for instructions.

- To set Demand intervals: from the Device Profile menu click **Revenue and Energy Settings**>**Demand Integration Intervals** and set the desired intervals. See Chapter 3 of the *Communicator EXT User Manual* for instructions.

- To set Cumulative Demand Type, from the Device Profile menu click **Revenue and Energy Settings**>**Cumulative Demand Type** and select Block or Rolling Window Average. See Chapter 3 of the *Communicator EXT User Manual* for instructions.

Chapter 9
Nexus® External Output Modules

9.1: Hardware Overview

■ All Nexus® **External Output modules** have the following components:

- **Female RS485 Side Port**: use to connect to another module's male RS485 side port.
- **Male RS485 Side Port**: use to connect to the Nexus® 1250/1252 meter's Port 3 or 4 or to another module's female RS485 side port. See Figure 9.2 for wiring details.
- **Output Port**: used for functions specific to the type of module. Size and pin configuration vary depending on the type of module.
- **Reset Button**: Press and hold for three seconds to reset the module's baud rate to 57600, and its address to 247 for 30 seconds.
- **LEDs**: when flashing, signal that the module is functioning.
- **Mounting Brackets (MBIO)**: used to secure one or more modules to a flat surface.

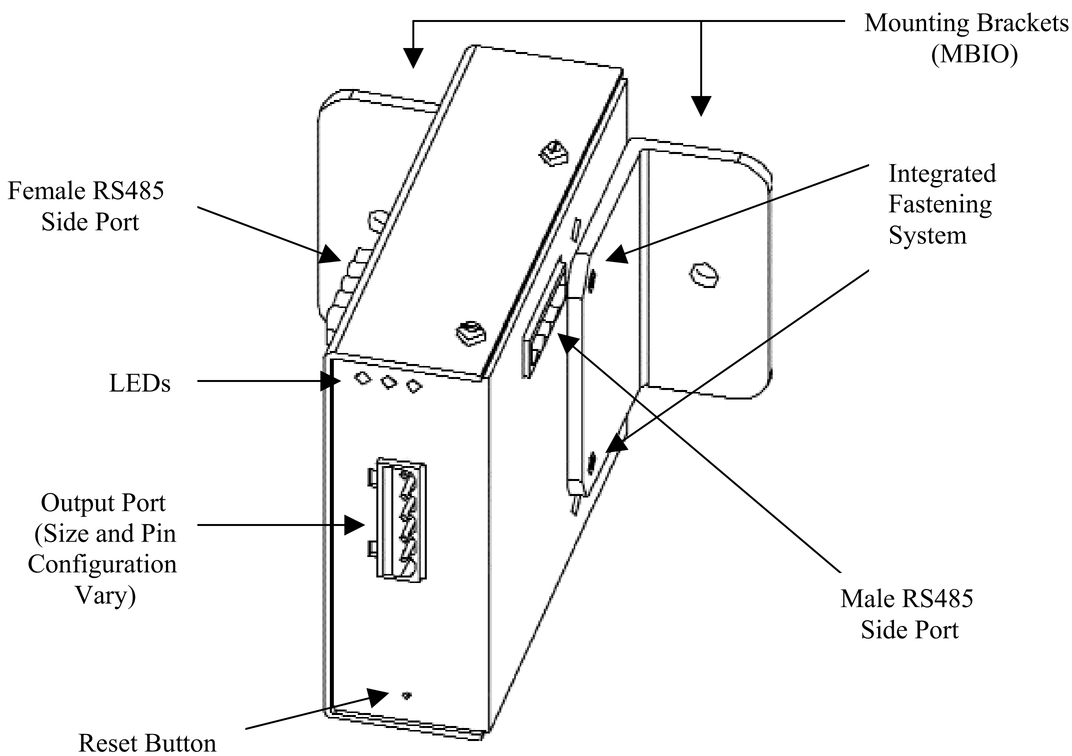
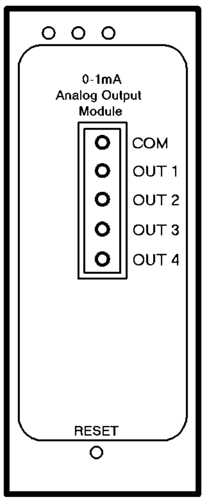


Figure 9.1: Output Module Components

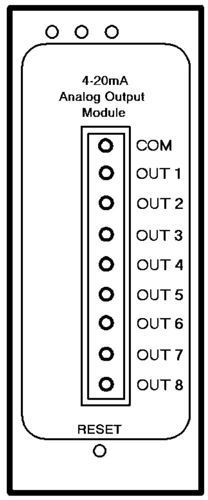
9.1.1: Port Overview

■ All Electro Industries Output Modules have ports through which they interface with other devices.
The port configurations are variations of the three types shown below.

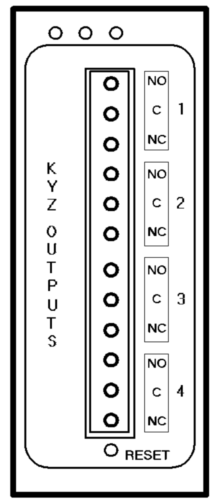
Four Analog Outputs (0-1mA and 4-20mA)



Eight Analog Outputs (0-1mA and 4-20mA)



Four Relay Outputs or Four KYZ Outputs



9.2: Installing Nexus® External Output Modules

- Output modules must use the Nexus® 1250/1252 meter's Port 3 or 4. Six feet of RS485 cable harness is supplied. Attach one end of the cable to the port (connectors may not be supplied); insert the other end into the communication pins of the module's Male RS485 Side Port. See Figure 9.2 below. See Section 9.3 for details on using multiple Output modules.

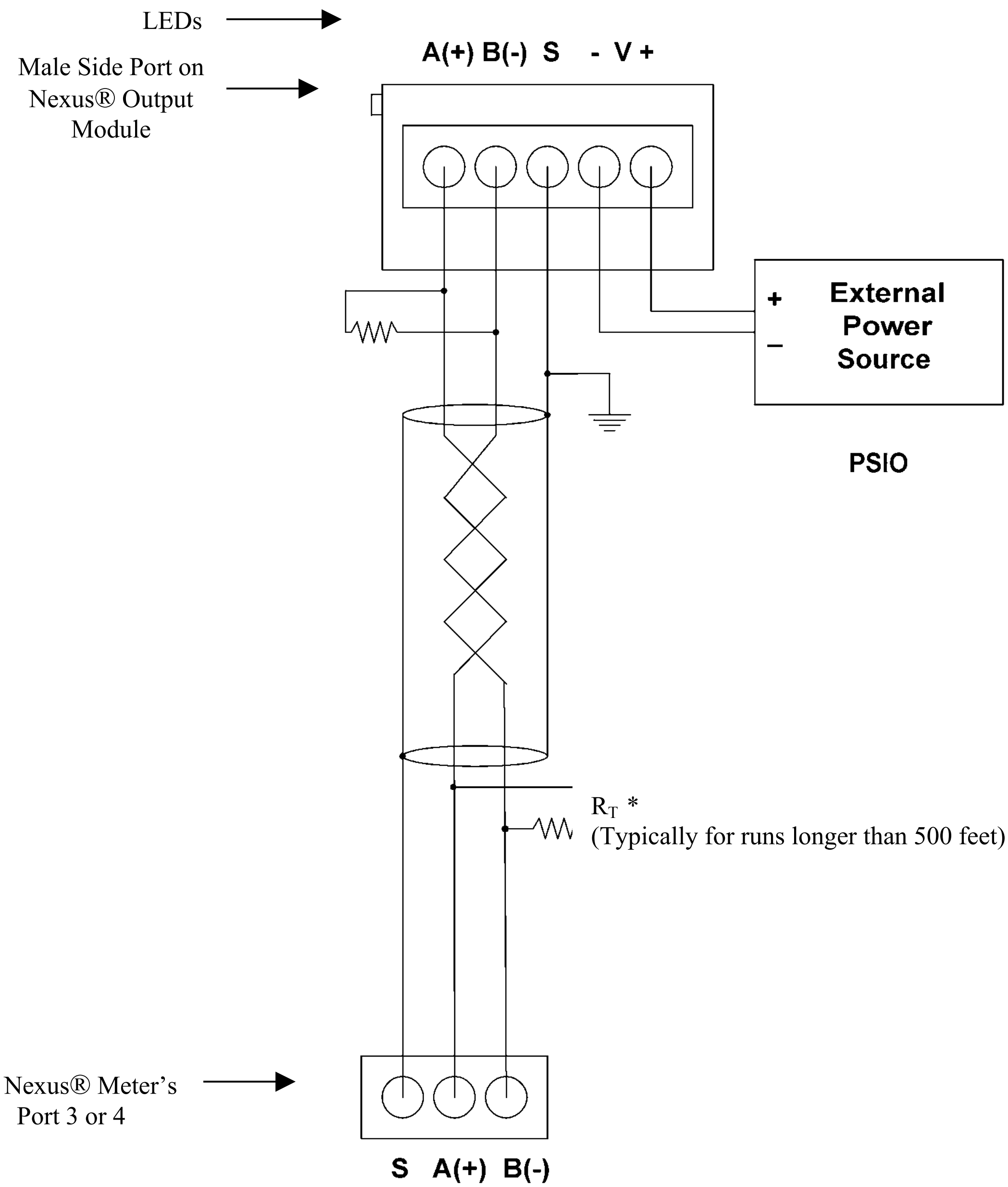


Figure 9.2: Nexus® Meter Connected to Output Module

***NOTE:** Termination Resistors are only needed, typically, with runs of more than 500 feet. The meter has some level of termination internally that are sufficient for shorter distances.

9.2.1: Power Source for Output Modules

- The Nexus® 1250/1252 meter will supply power to up to four Output Modules, depending on the type of module (Refer to module specifications, later in this chapter.) For additional modules, you must use an external power source, such as the EIG **PSIO** (12V). **Refer to Sections 5.12 and 5.13 to determine power needed.** RS485 communication is viable for up to 4000 feet (1219 meters).

  You must also do the following:

  1. Connect the A(+) and B(-) terminals on the Nexus® meter to the A(+) and B(-) terminals of the male RS485 port.
  2. Connect the shield to the shield **(S) terminal**. The (**S**) terminal on the Nexus® meter is used to reference the Nexus® meter's port to the same potential as the source. **It is not an earth to ground connection. You must also connect the shield to earth-ground at one point**.
  3. Put termination resistors at each end, connected to the A(+) and B(-) lines. RT is ~120 Ohms.
     NOTE: Refer to Section 5.3 for RT Explanation.
  4. Connect a power source to the front of the module.

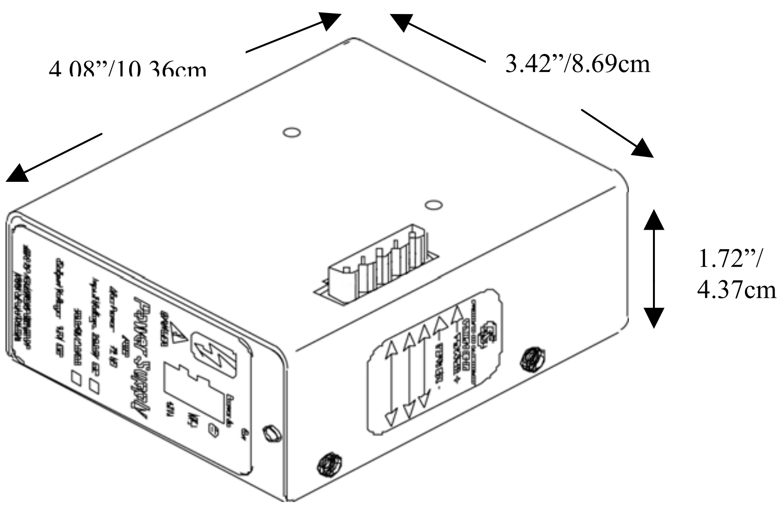
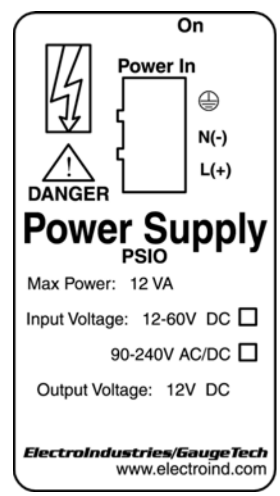
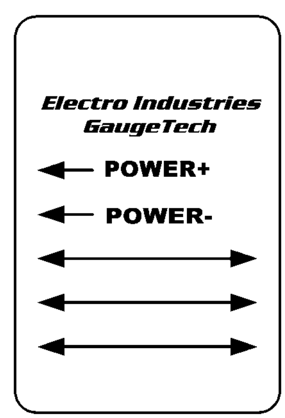


Figure 9.3: The PSIO Power Source (Side View)
Showing Male RS485 Side Port

SIDE LABEL



TOP LABEL



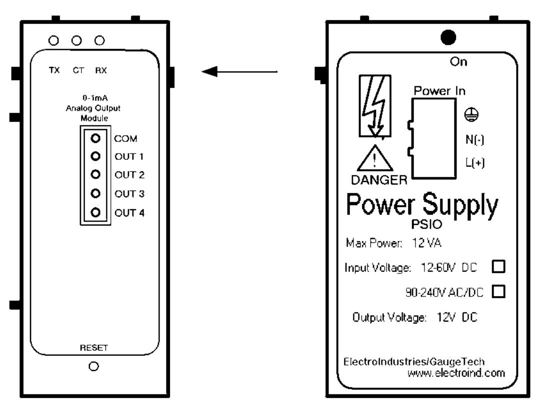


Figure 9.4: Power Flow from PSIO to Output Module

Figure 9.5: Labels for PSIO

9.3: Using PSIO with Multiple Output Modules

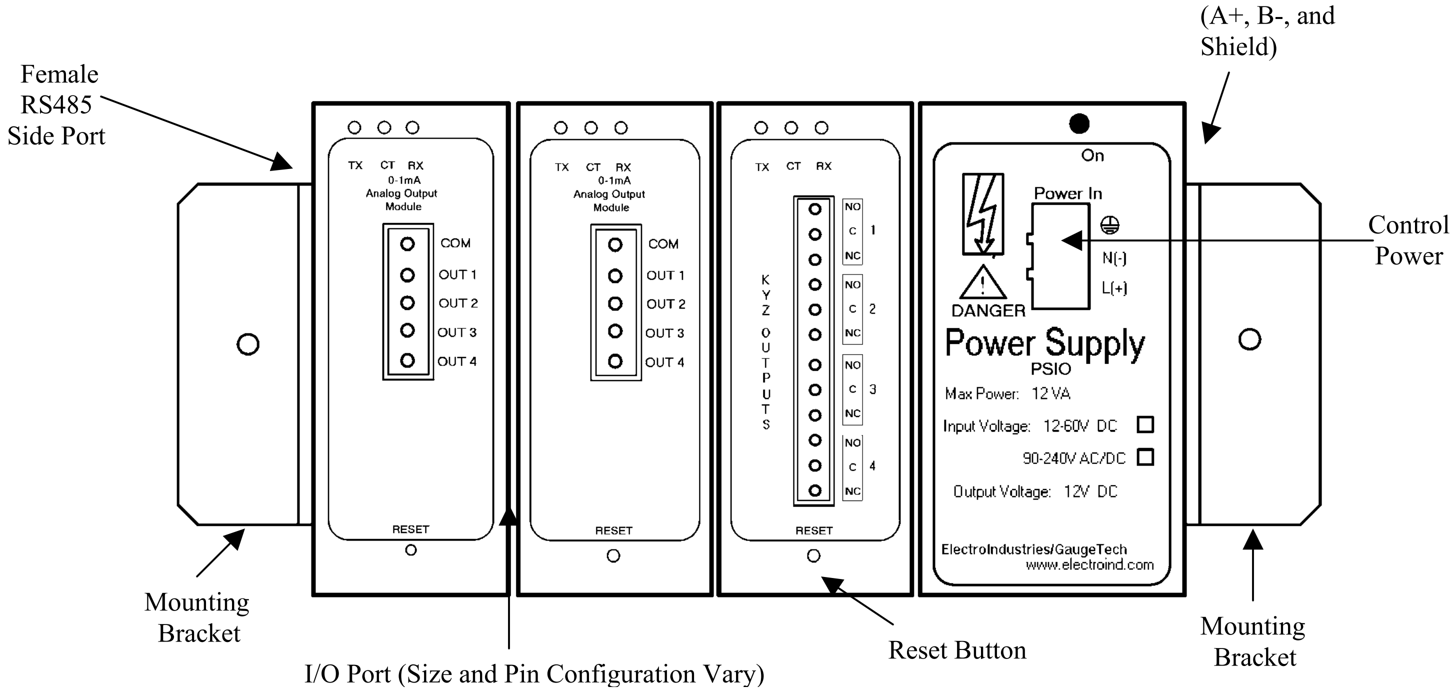


Figure 9.6: Using PSIO with Multiple Output Modules

NOTE: PSIO must be to the right of the Output Modules, when viewing its side label (as shown in the figure above).

9.3.1: Steps for Attaching Multiple Output Modules

1. Each Output module in a group must be assigned a unique address. See the *Communicator EXT User Manual* for instructions on configuring and programming the Output Modules.

2. Determine how many power sources (such as PSIO) are needed for the number of modules in use. See Section 9.2.1 for details.

3. Starting with the left module and using a slotted screwdriver fasten the first Output Module to the left Mounting Bracket. The left Mounting Bracket is the one with the PEM. Fasten the internal screw **tightly** into the left Mounting Bracket.

4. Slide the female RS485 port into the male RS485 side port to connect the next Output module to the left module. **Fasten together enough to grab but do not tighten, yet**
   One by one combine the modules together using the **Integrated Fastening System** (See Figure 9.1).
   If you require an additional power supply, attach a PSIO (power supply) to the right of each group of 4 Output Modules (see Figure 9.3).

   NOTE: The PB1 can also be used if you need a Low Voltage Power Supply. The PB1 must be mounted separately.

5. Once you have combined all of the Output Modules together for the group, fasten them tightly. **This final tightening locks the group together as a unit.**

6. Attach the right Mounting Bracket to the right side of the group using the small Phillips Head screws provided.

7. Mount the attached group of modules on a secure, flat surface. This insures that all modules stay securely connected.

9.4: Factory Settings and Reset Button

- **Factory Settings**:
  All Nexus® Output Modules are shipped with a preset address and a baud rate of 57600. See the following list.

Model #	Module	Factory-Set Address
1mAON4	0±1mA, 4-Channel Analog Output	128
1mAON8	0±1mA, 8-Channel Analog Output	128
20mAON4	4–20mA, 4-Channel Analog Output	132
20mAON8	4–20mA, 8-Channel Analog Output	132
4RO1	4 Latching Relay Outputs	156
4PO1	4 KYZ Pulse Outputs	160

- **Reset Button**:
  If there is a communication problem or if you are unsure of a module's address and baud rate, press and hold the **Reset** button for 3 seconds; **the module will reset to a default address of 247 at 57600 baud rate for 30 seconds**.

9.5: Analog Transducer Signal Output Modules

Analog Transducer Signal Output Modules Specifications	
Model Numbers	1maAON4: 4-Channel Analog Output, 0±1mA
	1mAON8: 8-Channel Analog Output, 0±1mA
	20mAON4: 4-Channel Analog Output, 4–20mA
	20mAON8: 8-Channel Analog Output, 4–20mA
Accuracy	0.1% of Full Scale
Scaling	Programmable
Communication	RS485, Modbus RTU
	Programmable Baud Rates: 4800, 9600, 19200, 57600
Power Requirement	12–20V_{dc} at 50–200mA; Nexus® 1250/1252 Meter supports up to 2 Modules
Operating Temperature	(-20 to 70)°C / (-4 to +158)°F
Maximum Load Impedance	0±1mA: 10k W; 4–20mA: 500 W
Factory Settings	Modbus Address: 1mAON4, 0-1mA: 128 1mAON8, 0-1mA: 128 20mAON4, 4–20mA: 132, 20mAON8, 4-20mA: 132
	Baud Rate: 57600
	Transmit Delay Time: 0
Default Settings (Reset Button)	Modbus Address: 247
	Baud Rate: 57600
	Transmit Delay Time: 20msec

9.5.1: Overview

- The **Analog Transducer Signal Output Modules** (**0**±**1mA** or **4–20mA**) are available in either a **4-** or **8-channel** configuration. Maximum registers per request, read or write, is 17 registers.

- The Nexus® 1250/1252 meter supplies power for up to **two** connected Analog Output modules. See Section 9.2 for power and communication details. Refer to Sections 5.12 – 5.13 to determine if you need an additional power source, such as the EIG **PSIO**.

- All outputs share a single common point. This is also an isolated connection (from ground).

9.5.2: Normal Mode

- **Normal Mode** is the same for the 0-1mA and the 4-20mA Analog Output Modules except for the number of processes performed by the modules.

  Both devices:

  1. Accept new values through communication.
  2. Output current loops scaled from previously accepted values.

  The 0-1mA module includes one more process in its Normal Mode:

  3. Read and average the A/D and adjust values for Process 2, above.

- The device operates with the following default parameters:

Address	247 (F7H)
Baud Rate	57600 Baud
Transmit Delay Time	0

9.6: Digital Dry Contact Relay Output (Form C) Module

Digital Dry Contact Relay Output (Form C) Module Specifications	
Model Number	4RO1: 4 Latching Relay Outputs
Accuracy	0.1% of Full Scale
Scaling	Programmable
Communication	RS485, Modbus RTU
	Programmable Baud Rates: 4800, 9600, 19200, 57600
Power Requirements	12–20V_{dc} at 50–200mA; Nexus® 1250/1252 Meter supports up to 4 Modules
Operating Temperature	(-20 to 70)°C / (-4 to +158)°F
Maximum Load Impedance	0-1mA: 10k W; 4-20mA: 500 W
Factory Settings	Modbus Address: 156
	Baud Rate: 57600
	Transmit Delay Time: 0
Default Settings (Reset Button)	Modbus Address: 247
	Baud Rate: 57600
	Transmit Delay Time: 20msec

9.6.1: Overview

- The **Relay Output Module** consists of **four Latching Relay Outputs**. In Normal Mode, the device accepts commands to control the relays. Relay output modules are triggered by limits programmed with the Communicator EXT software. See the *Communicator EXT User Manual* for details on programming limits.

- The Nexus® 1250/1252 meter supplies power for up to **4** connected Relay Output modules. See Section 9.2 for power and communication details. Refer to Sections 5.12 - 5.13 to determine if you need an additional power source, such as the EIG **PSIO**.

- Each latching relay will hold its state in the event of a power loss.

9.6.2: Communication

- Maximum registers per request, read or write, is 4 registers.orm

- The device operates with the following default parameters:

Address	247 (F7H)
Baud Rate	57600 Baud
Transmit Delay Time	20msec

9.6.3: Normal Mode

- Normal Mode consists of one process: the device accepts new commands to control the relays.

9.7: Digital Solid State Pulse Output (KYZ) Module

Digital Solid State Pulse Output (KYZ) Module Specifications	
Model Number	4PO1
Communication	RS485, Modbus RTU
	Programmable Baud Rates: 4800, 9600, 19200, 57600
Power Requirement	12–20V_{dc} at 50–200mA; Nexus® 1250/1252 Meter supports up to 4 Modules
Operating Temperature	(-20 to 70)°C / (-4 to +158)°F
Voltage Rating	Up to 300V_{dc}
Commands Accepted	Read and Write with at least 4 registers of data per command
Memory	256 byte I2C EEPROM for storage of Programmable Settings and Nonvolatile Memory
Factory Settings	Modbus Address: 160
	Baud Rate: 57600
	Transmit Delay Time: 0
Default Settings (Reset Button)	Modbus Address: 247
	Baud Rate: 57600
	Transmit Delay Time: 20msec

9.7.1: Overview

- The **KYZ Pulse Output Modules** have **4 KYZ Pulse Outputs** and accept Read and Write Commands with at least **4 registers** of data per command. Digital Solid State Pulse Output **(KYZ) Modules** are user programmed to reflect VAR-hours, WATT-hours, or VA-hours.

- The Nexus® 1250/1252 meter supplies power for up to **4** connected KYZ Pulse Output modules. See Section 9.2 for power and communication details. Refer to Sections 5.12 - 5.13 to determine if you need an additional power source, such as the EIG **PSIO**.

- **NC** = Normally Closed; **NO** = Normally Open; **C** = Common.

9.7.2: Communication

- Maximum registers per request, read or write, is 4 registers.orm

- The device operates with the following default parameters:

Address	247 (F7H)
Baud Rate	57600 Baud
Transmit Delay Time	20msec

9.7.3: Normal Mode

- Energy readings are given to the device frequently. The device generates a pulse at each channel after a certain energy increase.

- Normal Operation consists of three processes:

1. The **first process** accepts writes to registers 04097 - 04112. Writes can be up to four registers long and should end on the fourth register of a group (register 04100, or registers 04103-04112 or registers 04109-04112). These writes can be interpreted as two-byte, four-byte, six-byte or eight-byte energy readings. The reception of the first value for a given channel provides the initial value for that channel. Subsequent writes will increment the Residual for that channel by the difference of the old value and the new value. The previous value is then replaced with the new value. Attempting to write a value greater than the programmed Rollover Value for a given channel is completely ignored and no registers are modified. If the difference is greater than half of the programmed Rollover Value for a given channel, the write does not increment the Residual but does update the Last Value. Overflow of the Residual is not prevented.

3. The **second process** occurs in the main loop and attempts to decrement the Residual by the Programmed Energy/Pulse Value. If the Residual is greater than the Programmed Energy/Pulse Value and the Pending Pulses Value for that channel is not maxed, then Residual is decremented appropriately and the Pending Pulses is incremented by two, signifying two more transitions and one more pulse.

3. The **third process** runs from a timer that counts off pulse widths from the Programmable Minimum Pulse Width Values. If there are Pulses Pending for a channel and the delay has passed, then the Pulses Pending is decremented for that channel and the Output Relay is toggled.

- Operation Indicator (0000H = OK, 1000H = Problem):
  Bit 1: 1 = EEPROM Failure
  Bit 2: 1 = Checksum for Communications Settings bad
  Bit 3: 1 = Checksum for Programmable Settings bad
  Bit 4: 1 = 1 or more Communications Settings are invalid
  Bit 5: 1 = 1 or more Programmable Settings are invalid
  Bit 6: 1 = 1 or more Programmable Settings have been modified
  Bit 7: 1 = Forced Default by Reset Value
  Bit 15: 1 = Normal Operation of the device is disabled

9.8: Specifications

- **Analog Transducer Signal Outputs** (Up to **two** modules can be used with the Nexus® 1250/1252 meter.)

  1mAON4: 4 Analog Outputs, scalable, bidirectional.
  1mAON8: 8 Analog Outputs, scalable, bidirectional.
  20mAON4: 4 Analog Outputs, scalable.
  20mAON8: 8 Analog Outputs, scalable.

- **Digital Dry Contact Relay Outputs** (**Multiple** modules can be used.)

  4RO1: 4 Relay Outputs 10 Amps, 125Vac, 30Vdc, Form C.

- **Digital Solid State Pulse Outputs** (**Multiple modules** can be used.)

  4PO1: 4 Solid State Pulse Outputs, Form A KYZ pulses.

- **Other Output Module Accessories**

  PSIO: External Power Supply, which is necessary if you are connecting more than 2 to 4 Output modules to a Nexus® 1250/1252 meter, determined by the type of Output Modules you are connecting.
  MBIO: Bracket for surface-mounting Output modules to any enclosure.

Chapter 10
Nexus® Meter with Internal Modem Option (INP2)

10.1: Hardware Overview

- The Nexus® 1250/1252 meter with the **INP2**, **Internal Modem Option**, has all the components of the standard Nexus® meter plus the capability of connecting to a PC via a standard phone line. No additional hardware is required to establish this connection.

  If desired, the internal expansion port of the Nexus® 1250/1252 meter can be configured with an internal 56K bps modem. This gives the meter **Dial-In** and **Dial-Out** capability without additional hardware. This configuration of the meter is ideal for small remote applications.

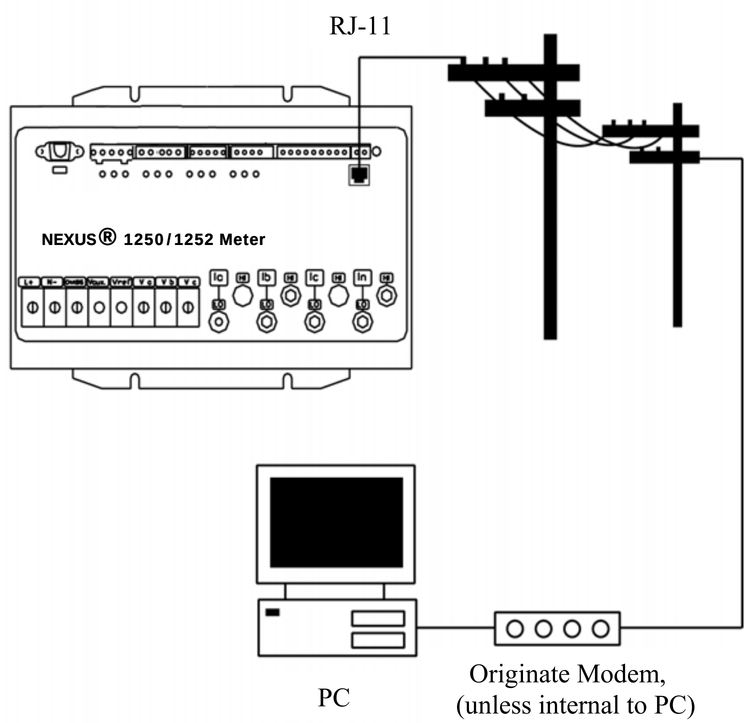


Figure 10.1: Nexus® 1250/1252 Meter with Internal Modem Option

10.2: Hardware Connection

- Use **RJ-11** Standard Telephone Line to connect with the Nexus® 1250/1252 meter. The RJ-11 line is inserted into the RJ-11 Port on the face of a Nexus® meter with the Internal Modem Option. The RJ-11 connection is virtually unlimited, since it utilizes a **PSTN** (Public Switched Telephone Network).

10.3: Dial-In Function

- The modem continuously monitors the telephone line to detect an incoming call. When an incoming call is detected, the modem will wait a pre-programmed number of rings and answer the call. The modem can be programmed to check passwords and lock out a user after unsuccessful attempts to connect.

  When an incoming call is successfully connected, the control of communications is passed to the calling software program. The modem will respond to computer demands to download data or perform other actions authorized by the meter's passwords.

10.4: Dial-Out Function

- The **Dial-Out Function** enabled by the INP2 Option allows the meter to automatically report certain conditions without direct user oversight. The modem normally polls the meter to determine if any abnormal or reportable conditions exist, such as those in the following list. If such conditions are found, the modem checks meter conditions and events, which have been programmed through Communicator EXT, to determine if a call should be placed.

  - Are any meter set-point limits exceeded?
  - Has the status of the High-Speed Inputs changed?
  - Has a waveform been recorded?
  - Has a power quality event been recorded?
  - Has a control output changed?
  - Is either history log approaching a full condition?
  - Is the event log approaching a full condition?
  - Is any other log approaching a full condition?
  - Has the Modem Password failed?
  - Has communication with the Nexus® meter failed?

- If any of the monitored events exist, the modem will automatically initiate a call to a specified location to make a report or perform some other function. For log full conditions, the meter will automatically download the log(s) that are nearing the full state. The modem can be programmed to call two different numbers to make the required reports: Primary and Backup.

- The modem can be programmed with an ASCII string for identification purposes. If this string is present, the modem will play the string to the host computer upon connection to identify the meter to the host software. Refer to the *Communicator EXT User Manual* for programming details.

Chapter 11
Nexus® Meter with Internal Network Option (INP200) Utilizing Rapid Response™ Technology

11.1: Hardware Overview

- The Nexus® 1250/1252 meter with the **Internal Network Option** (**INP200**) has all the components of the standard Nexus® meter, plus giving you the capability of connecting to multiple PC's via Modbus/TCP over the Ethernet and providing a DNP LAN/WAN connection. Additional hardware is not required to establish a connection from a network to a Nexus® meter with the Internal Network Option. Using Electro Industries' Rapid Response™ technology, the INP200 Ethernet card offers 100BaseT design optimized for downloads and data collection.

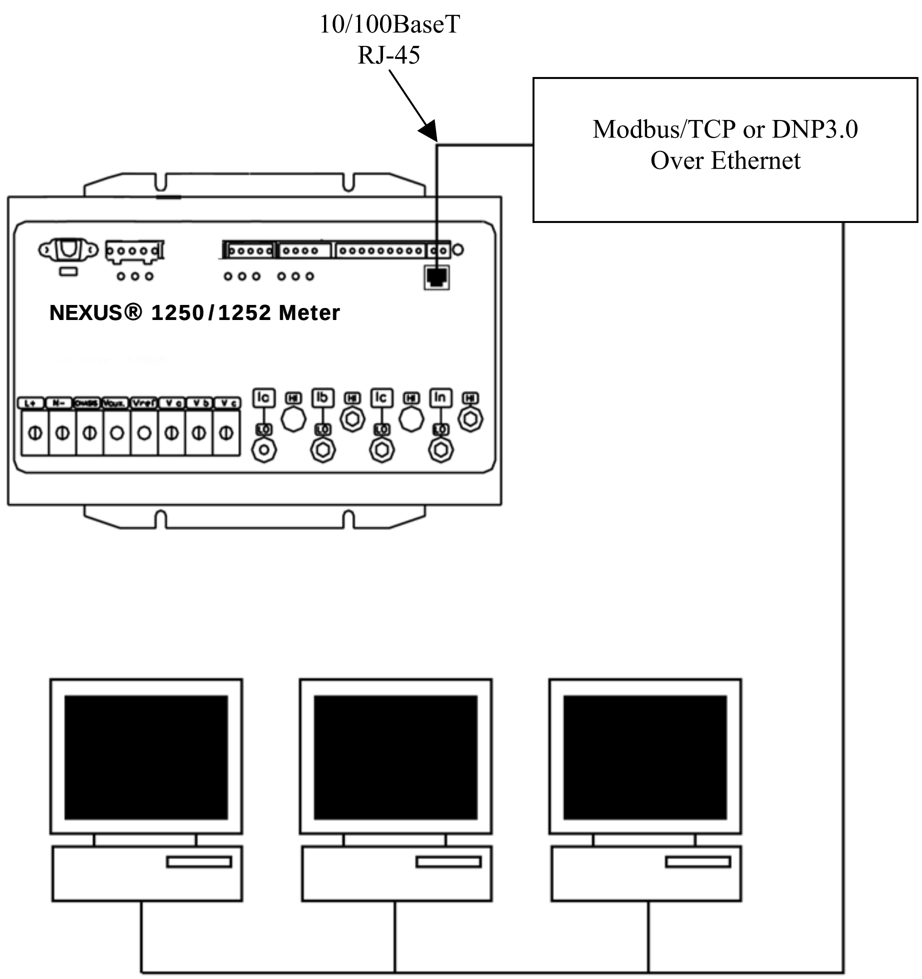


Figure 11.1: Nexus® Meter with Internal Network Option

- The Internal Network Option of the Nexus® meter is an extremely versatile communications tool. The Internal Network Option:
    - Adheres to IEEE 802.3 Ethernet standard using TCP/IP
    - Utilizes simple and inexpensive 10/100BaseT wiring and connections
    - Plugs into your network using built-in RJ-45 jack
    - Is programmable to any IP address, subnet mask and gateway requirements
    - Communicates using the industry-standard Modbus/TCP and DNP LAN/WAN protocols.
- The Internal Network Option allows multiple simultaneous connections (via LAN) to the Nexus® meter. You can access the meter with **SCADA**, **MV90** and **RTU** simultaneously.
- The Internal Network Option allows multiple users running **Communicator EXT** software to access the meter concurrently.

11.2: Network Connection

- Use Standard RJ-45 10/100BaseT cable to connect with the Nexus® meter. The RJ-45 line is inserted into the RJ-45 Port on the face of a Nexus® 1250/1252 meter with the Internal Network Option.
- Set the **IP Address** using the following steps:
  (Refer to Section 3.3.5 of the *Communicator EXT User Manual* for more detailed instructions.)

  1. From the **Device Profile** screen, double-click **General Settings**> **Communications**, then double-click on any of the ports. The **Communications Settings** screen opens.
  2. In the Network Settings section enter the following data. (Consult with your systems manager if you do not know this information.)

     IP Address: 10.0.0.1 (Example)
     Subnet Mask: 255.255.255.0 (Example)
     Default Gateway: 0.0.0.0 (Example)

  3. Click **OK** to return to the **Device Profile** screen.

- Once the above parameters have been set, Communicator EXT will connect via the network using a Device Address of “1” and the assigned IP Address when you follow these steps:

  1. Open **Communicator EXT**.
  2. Click the **Connect** icon in the icon tool bar. The **Connect** screen opens.
  3. Click the **Network** button at the top of the screen. Enter the following information:
     Device Address: **1**
     Host: **IP Address**
     Network Port: **502**
     Protocol: **Modbus TCP**
  4. Click the **Connect** button at the bottom of the screen. Communicator EXT connects to the meter via the network.

NOTE: Nexus® meters do not support web pages, email, FTP, or DHCP communication.

Chapter 12
Flicker and EN50160 Analysis

12.1: Overview

Flicker is the sensation that is experienced by the human visual system when it is subjected to changes occurring in the illumination intensity of light sources. The primary effects of Flicker are headaches, irritability and, sometimes, epileptic seizures.

IEC 61000-4-15 and former **IEC 868** describe the methods used to determine Flicker severity. This phenomenon is strictly related to the sensitivity and the reaction of individuals. It can only be studied on a statistical basis by setting up suitable experiments among people.

The Nexus® 1250 meter and the Nexus® 1252 meter with V-1 (base configuration) offers Flicker monitoring and analysis. The Nexus® 1252 meter with V-2 has EN50160 Power Quality Compliance analysis for Flicker and other power quality measurements. (Refer to the V-Switch™ key information in Chapter 2.) Refer to Chapters 16 (EN50160 Power Quality Compliance Analysis) and 17 (EN50160 Flicker) of the *Communicator EXT User Manual* for additional information.

12.2: Theory of Operation

Flicker can be caused by voltage variations that are in turn caused by variable loads, such as arc furnaces, laser printers and microwave ovens. In order to model the eye brain change, which is a complex physiological process, the signal from the power network has to be processed while conforming with Figure 12.1, shown on page 12-3.

- **Block 1** consists of scaling circuitry and an automatic gain control function that normalizes input voltages to Blocks 2, 3 and 4. For the specified 50 Hz operation, the voltage standard is 230 V RMS.

- **Block 2** recovers the voltage fluctuation by squaring the input voltage scaled to the reference level. This simulates the behavior of a lamp.

- **Block 3** is composed of a cascade of two filters and a measuring range selector. In this implementation, a log classifier covers the full scale in use so the gain selection is automatic and not shown here. The first filter eliminates the DC component and the double mains frequency components of the demodulated output.

  The configuration consists of a .05 Hz Low High Pass filter and a 6 Pole Butterworth Low Pass filter located at 35 Hz. The second filter is a weighting filter that simulates the response of the human visual system to sinusoidal voltage fluctuations of a coiled filament, gas-filled lamp (60 W - 230 V). The filter implementation of this function is as specified in IEC 61000-4-15.

- **Block 4** is composed of a squaring multiplier and a Low Pass filter. The Human Flicker Sensation via lamp, eye and brain is simulated by the combined non-linear response of Blocks 2, 3 and 4.

- **Block 5** performs an online statistical cumulative probability analysis of the flicker level. Block 5 allows direct calculation of the evaluation parameters Pst and Plt.

■ **Flicker Evaluation** occurs in the following forms: **Instantaneous**, **Short Term** or **Long Term**. Each form is detailed below:

- **Instantaneous Flicker Evaluation**
  An output of 1.00 from Block 4 corresponds to the Reference Human Flicker Perceptibility Threshold for 50% of the population. This value is measured in Perceptibility Units (PU) and is labeled Pinst. This is a real time value and it is continuously updated.

- **Short Term Flicker Evaluation**
  An output of 1.00 from Block 5 (corresponding to the Pst value) corresponds to the conventional threshold of irritability per IEC 1000-3-3. In order to evaluate flicker severity, two parameters have been defined: one for the short term called Pst (defined in this section) and one for the long term called Plt (defined in the next section).

  The standard measurement time for Pst is 10 minutes. Pst is derived from the time at level statistics obtained from the level classifier in Block 5 of the flicker meter. The following formula is used:

$$P_{st} = \sqrt{0.0314P_{0.1} + 0.0525P_{1s} + 0.0657P_{3s} + 0.28P_{10s} + 0.08P_{50s}}$$

  Where the percentiles P(0.1), P(1), P(3), P(10), P(50) are the flicker levels exceeded for 0.1, 1, 2, 20 and 50% of the time during the observation period. The suffix S in the formula indicates that the smoothed value should be used. The smoothed values are obtained using the following formulas:

  P(1s) = (P(.7) + P(1) + P(1.5))/3
  P(3s) = (P(2.2) + P(3) + P(4))/3
  P(10s) = (P(6) + P(8) + P(10) + P(13) + P(17))/5
  P(50s) = (P(30) + P(50) + P(80))/3

  The .3-second memory time constant in the flicker meter ensures that P(0.1) cannot change abruptly and no smoothing is needed for this percentile.

- **Long Term Flicker Evaluation**
  The 10-minute period on which the short-term flicker severity is based is suitable for short duty cycle disturbances. For flicker sources with long and variable duty cycles (e.g. arc furnaces) it is necessary to provide criteria for long-term assessment. For this purpose, the long-term Plt is derived from the short-term values over an appropriate period. By definition, this is 12 short-term values of 10 minutes each over a period of 2 hours. The following formula is used:

$$P_{lt} = \sqrt[3]{\frac{\sum_{i=1}^{N} P_{sti}^3}{N}}$$

  Where Psti (i = 1, 2, 3, ...) are consecutive readings of the short-term severity Pst.

- **Summary**

  Flicker = Changes in the illumination of light sources due to cyclical voltage variations.
  Pinst = Instantaneous flicker values in Perceptibility Units (PU).
  Pst = Value based on 10-minute analysis.
  Plt = Value based on 12 Pst values.
  Measurement Procedure:
  1. Original Signal with amplitude variations.
  2. Square demodulator.
  3. Weighted filter.
  4. Low pass filter 1st order.
  5. Statistical computing.

- **Data available**

  Pst, Pst Max, Pst Min values for long term recording
  Plt, Plt Max, Plt Min values for long term recording

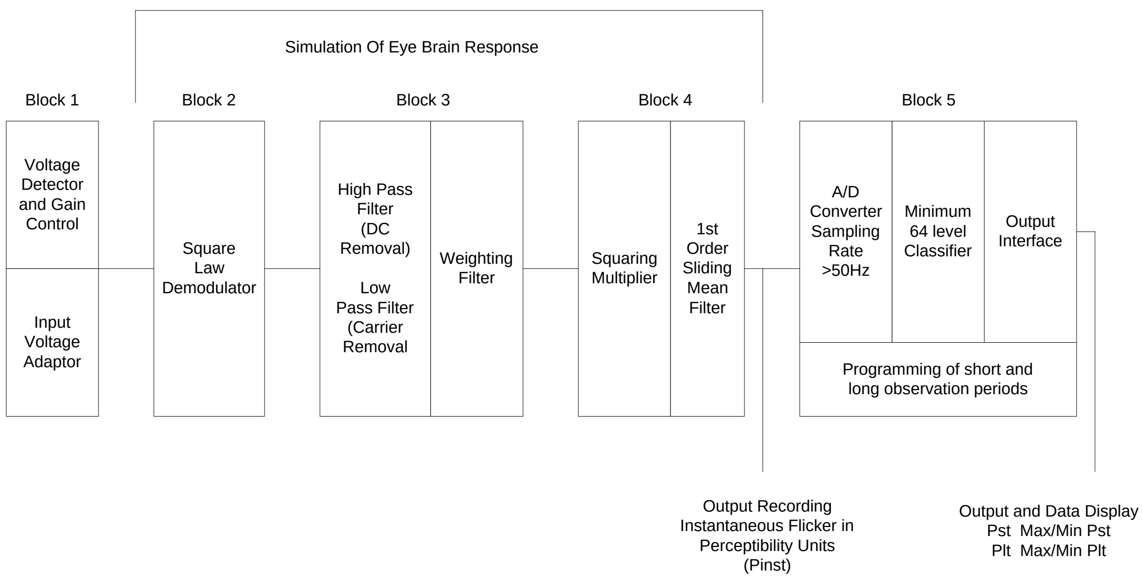
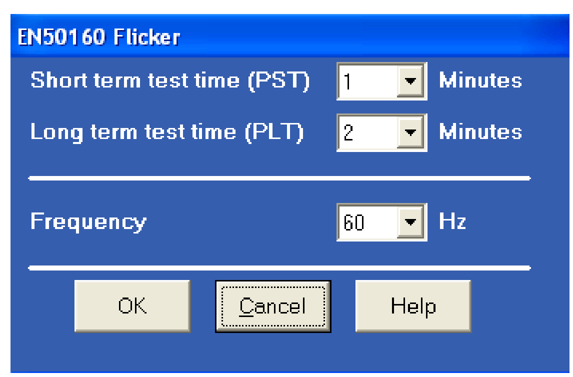


Figure 12.1: Simulation of Eye Brain Response

12.3: Flicker Setting (Nexus® 1250 meter and 1252 V-1)



You must set up several parameters to properly configure Flicker.
NOTE: If your Nexus® 1252 meter has V-Switch key 2, see Section 12.9 for instructions on configuring EN50160 Power Quality Compliance analysis, including Flicker.

1. Select the **Profile** icon from Communicator EXT's **Icon** bar.

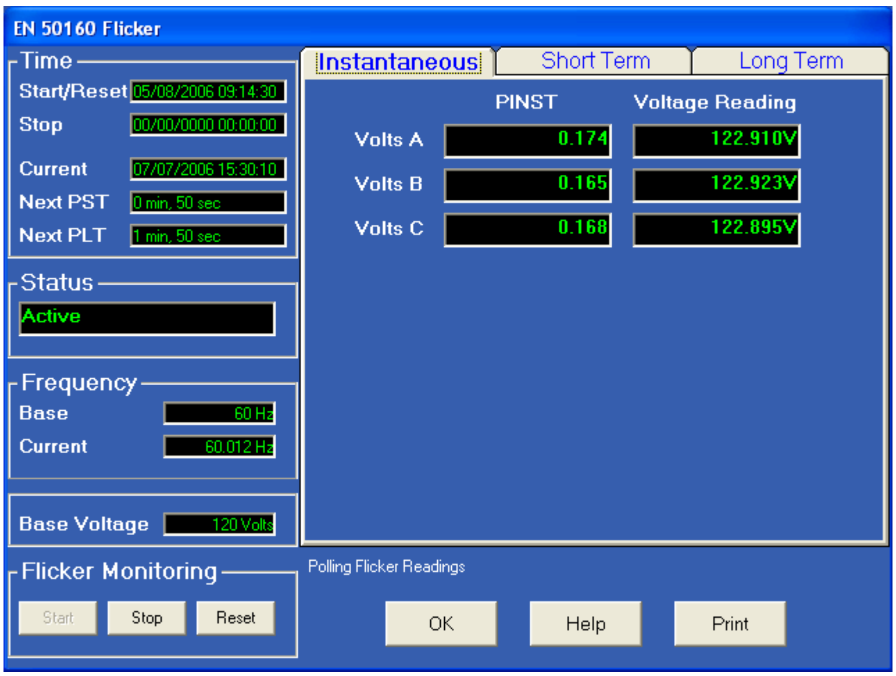
2. From the **Device Profile** screen, double-click **Power Quality and Alarm Settings>EN50160 Flicker**. You will see the screen shown on the right.

- Select a **Pst** time range from 1 to 10 minutes. The standard measurement period is nominally 10 minutes.
- Select a **Plt** time range from 1 to 240 minutes. The standard measurement is nominally 12 Pst periods (120 minutes). Plt time must always be equal to or great than and a multiple of Pst time. This is reflected in the available selections.
- Select the **frequency** of operation. 50 Hz is the approved frequency according to Flicker standards. A 60 Hz implementation is available and can be selected. Remember the voltage is normalized. For 50 Hz, the normalized voltage is 230 V and for 60 Hz, the normalized voltage is 120 V.

3. Press **OK** when you are finished; press **Help** for more information on this topic.

12.4: EN50160 Flicker Polling Screen

1. From the Communicator EXT **Title** bar, select **Real-Time Poll**>**Power Quality and Alarms**>**Flicker**. You will see the screen shown below.



Main screen:

This section describes the **Main Screen** functions. These functions are found on the left side of the screen.

Time:

- **Start/Reset** is the time when Flicker was started or reset. A Reset of Flicker causes the Max/Min values to be cleared and restarts the Flicker Pst and Plt timers. A Start of Flicker is also equivalent to a Reset in that the PST and PLT are restarted and the Max/Min Values are cleared.
- **Stop** corresponds to the time when Flicker is turned off.
- **Current** is the current clock time.
- **Next Pst** is the countdown time to when the next Pst value is available.

- **Next Plt** is the countdown time to when the next Plt value is available.

Status:
- Indicates the current status. **Active** = **On**. **Stopped** = **Off**.

Frequency:
- **Base** is the operating frequency (50 or 60 Hz) selected in the **EN50160 Flicker** screen (see Section 12.3).
- **Current** is the real-time frequency measurement of the applied voltage.

Base Voltage:
- The **normalized voltage** for the selected frequency (230 V for 50 Hz or 120 V for 60 Hz)

Flicker Monitoring:
- Clicking on **Stop** causes Flicker to stop being processed and freezes all the current values. Stop Time is recorded and the current Max/Min values are cleared.
- Clicking on **Start** starts Flicker processing. Start Time is recorded.
- Clicking on **Reset** causes the Max/Min values to be cleared and restarts the Flicker Pst and Plt timers.

Use the **tabs** at the top of the screen to navigate to the **Instantaneous**, **Short Term**, and **Long Term Readings** views, shown on the right side of the screen.

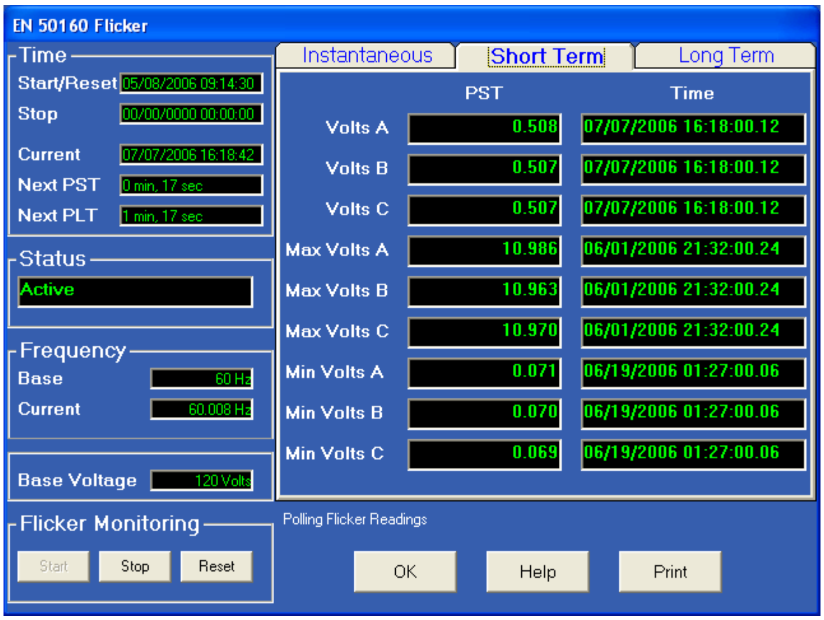
Instantaneous Readings:

NOTE: The **Instantaneous** view is the default of this screen. (See the screen pictured on the previous page.) If you are in the **Short** or **Long Term** views, click on the **Instantaneous** tab to display this view.
- The **PU** values, **Pinst** for Voltage Inputs **Va**, **Vb** and **Vc** are displayed here and are continuously updated. The corresponding **Current Voltage** values for each channel are displayed for reference.

Short Term Readings:

Click on the **Short Term** tab to access a screen containing three groups of Pst readings.

Pst Readings Displayed:
- Current **Pst** values for **Va**, **Vb** and **Vc** and the time of computation.
- Current **Pst Max** values for **Va**, **Vb** and **Vc** since the last reset and the time of the last reset.
- Current **Pst Min** values for **Va**, **Vb** and **Vc** since the last reset and the time of the last reset.

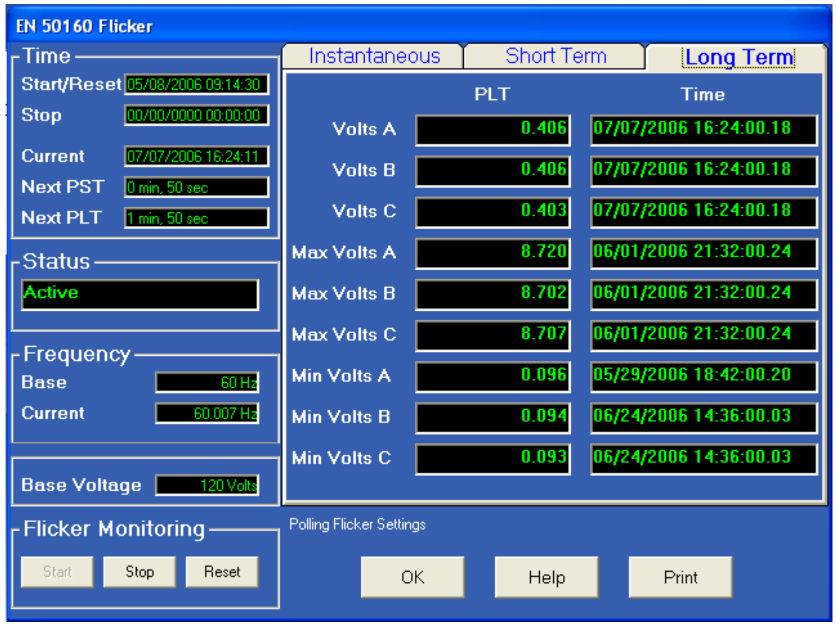


Long Term Readings:

Click on the **Long Term** tab to access a screen containing three groups of Plt readings.

Plt Readings Displayed:

- Current **Plt** values for **Va**, **Vb** and **Vc** and the time of computation
- Current **Plt Max** values for **Va**, **Vb** and **Vc** since the last reset and the time of the last reset.
- Current **Plt Min** values for **Va**, **Vb** and **Vc** since the last reset and the time of the last reset.



2. Click **OK** to exit the **EN50160 Flicker** Polling screen; click **Help** for more information on this topic; click **Print** to print all of the Readings views.

12.5: Logging

The Nexus® 1250/1252 meter is capable of logging Flicker values in an independent log. When Flicker is on, entries are made into the log in accordance with the times that associated values occur. **Pst**, **Pst Max**, **Pst Min**, **Plt**, **Plt Max**, **Plt Min**, **Start**/**Reset** and **Stop** times are all recorded. All values can be downloaded to the **Log Viewer** where they are available for graphing or export to another program, such as Excel. All Flicker values are predefined and cannot be changed. Refer to Chapter 8 of the *Communicator EXT User Manual* for additional instructions concerning the Flicker log.

12.6: Polling through a Communication Port

The **Pinst**, **Pst**, **Pst Max**, **Pst Min**, **Plt**, **Plt Max**, **Plt Min** values can be polled through the Communications Port. Refer to the Nexus® 1250 and 1252 meters' Modbus and DNP Mapping manuals for register assignments and data definitions.

12.7: Log Viewer

1. Open **Log Viewer** by selecting the **Open Logs** icon from Communicator EXT's **Icon** bar.
2. Using the menus at the top of the screen, select a meter, time ranges and values to access.
3. Click the **Flicker** icon.

The values and the associated time stamps (when the values occurred) are displayed in a grid box. Use the **buttons** at the bottom of the screen to create a graph or export the data to another program.

- **Graphed values** include **Pst** and **Plt Va**, **Vb** and **Vc**.
- **Displayed values** include **Pst** and **Plt Max** and **Min** for **Va**, **Vb** and **Vc**.

NOTE: Max and Min values are only displayed; they cannot be graphed. However, Max and Min values are available for export.

12.8: Performance Notes

- Pst and Plt average time are synchronized to the clock (e.g. for a 10 minute average, the times will occur at 0, 10, 20, etc.). The actual time of the first average can be less than the selected period to allow for initial clock synchronization.

- If the wrong frequency is chosen (e.g. 50Hz selection for a system operating at 60Hz), Flicker will still operate but the computed values will not be valid. Therefore, you should select the frequency setting with care.

- User settings are stored. If Flicker is on and power is removed from the meter, Flicker will still be on when power returns. This can cause gaps in the logged data.

- The Max and Min values are stored, and are not lost if the unit is powered down.

- Flicker meets the requirements of **IEC 61000-4-15** and former **IEC 868**. Refer to those specifications for more details, if needed. Meters with the **EN50160** option also meet the EN50160 conformance standards for Flicker. Refer to chapters 16 and 17 in the *Communicator EXT User Manual* for additional information.

- Operation is at 230V for 50Hz and 120V for 60Hz as per specification. If the input voltage is different, the system will normalize it to 230V or 120V for computational purposes.

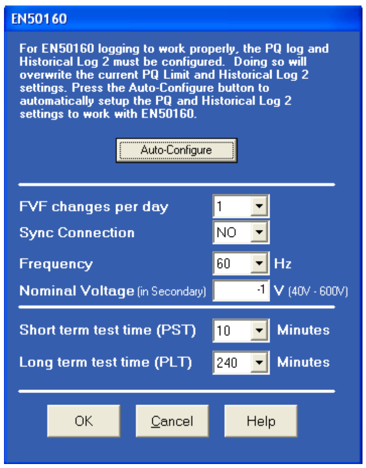
12.9: EN50160 Power Quality Compliance Analysis (Nexus® 1252 meter with V-2)

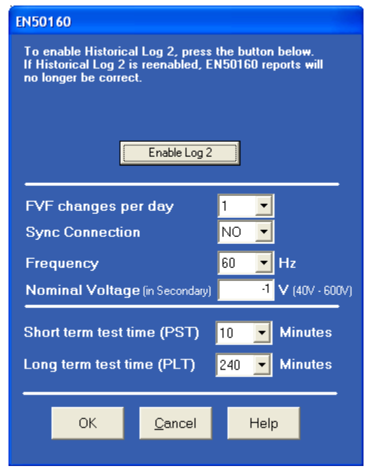
If your Nexus® 1252 meter is equipped with V-Switch™ key 2, you have access to the EN50160 PQ Compliance analysis function, as well as to EN50160 Flicker measurement.

12.9.1: EN50160 Configuration

1. Select the **Profile** icon from Communicator EXT's **Icon** bar.

2. From the **Device Profile** screen, double-click **Power Quality and Alarm Settings> EN50160.** Depending on your current setting, you will see one of the following screens.





3. The Nexus® 1252 meter with V-2 can use Historical Log 2 to record the results of EN50160 testing: you will see the display on the **left** if EN50160 logging has not been selected for the meter; you will see the screen on the **right** if it has already been selected.
   - To set up EN50160 recording, click **Auto-Configure**. Historical Log 2 will now be used for EN50160 logging, **only**.
   - If EN50160 recording is already active and you want to disable it, click **Enable Log 2**. This will disable the EN50160 logging in Historical Log 2. You can then configure Historical Log 2 normally. (See the *Communicator EXT User Manual*, Chapter 3, Section 3.6. for instructions)

   NOTE: It takes a week for the meter to collect all the necessary data for the EN50160 analysis.

4. Make the following selections:
   a. **FVF:** select the number of Fast Voltage Fluctuations that are acceptable per day.
   b. **Sync Connection:** select YES for a system with a synchronous connection to another system, NO if there is no such synchronous connection.
   c. Select your **Frequency** (50 Hz or 60Hz).
   d. **Nominal Voltage (in Secondary):** Enter the value for the Nominal voltage in Secondary that you want to use in the EN50160 analysis; for **example**, 120 V for a 60 Hz frequency, or 230 V for a 50 Hz frequency.
   e. **Short Term Test Time:** Select the time in minutes for the PST - short-term test. The available range is from **1-10** minutes.

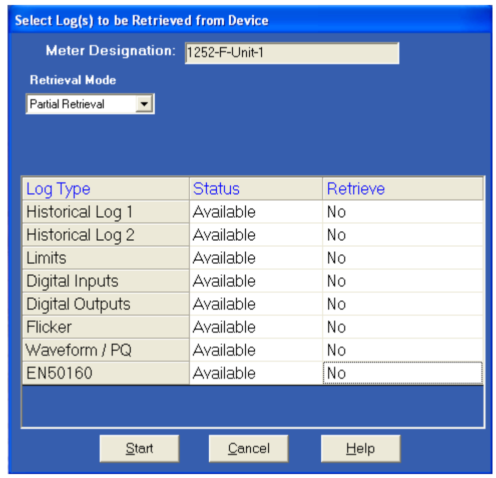
f. **Long Term Test Time:** Select the time in minutes for the LST - long-term test. The available range is **10-240** minutes, in multiples of 10 (10, 20, 30, etc.).

5. Click **OK**.

6. Click **Update Device** to send the new settings to the meter and return to the main Communicator EXT screen.

12.9.2: EN50160 IEC 61006-4-30 Analysis

NOTE: A full week of logging is necessary before an EN50160 analysis can be created.



1. From the Communicator EXT toolbar, click **Logs>Retrieve Logs from Device(s)** or click the **Retrieve Logs** icon. You will see the screen shown on the right.

2. Double-click the **No** to the right of **EN50160.**

4. You will see a pop-up window displaying the message: "Updated Related Logs (PQ and Historical Log 2)." Click **OK**.

5. The No changes to a **Yes** next to the Historical Log 2, Waveform/PQ, and EN50160 logs. Click **Start** to begin retrieving the logs. Communicator EXT retrieves the selected logs and automatically creates a database for you. Pop-ups confirm the retrieval and conversion.

6. The **Log Viewer** screen appears. (See *Communicator EXT User Manual*, Chapter 8, Section 8.4, for additional information on using the **Log Viewer**.)

7. Click the **EN50160** button. A screen shows the data points required. Click **YES**.

8. A list of all weeks collected for this meter is displayed. Information provided includes:

- Start/End Time of Week
- Device Name
- Nominal Frequency / Voltage
- Pass / Fail Value for each component

Select a **week** from those displayed.

8. Click the **IEC 61000-4-30** button at the bottom of the screen. A full analysis is generated. The **EN50160 HTML Viewer** screen is displayed. See Chapter 16 in the *Communicator EXT User Manual* for detailed instructions on using the EN50160 HTML Viewer screen.

Glossary

0.1 Second Values:	These values are the RMS values of the indicated quantity as calculated after approximately 50 milliseconds (3 cycles) of sampling.
1 Second Values:	These values are the RMS values of the indicated quantity as calculated after one second (60 cycles) of sampling.
Alarm:	An event or condition in a meter that can cause a trigger or call-back to occur.
Annunciator:	A short label that identifies particular quantities or values displayed, for example kWh.
Average (Current):	When applied to current values (amps) the average is a calculated value that corresponds to the thermal average over a specified time interval. The interval is specified by the user in the meter profile. The interval is typically 15 minutes. So, Average Amps is the thermal average of amps over the previous 15-minute interval. The thermal average rises to 90% of the actual value in each time interval. For example, if a constant 100amp load is applied, the thermal average will indicate 90 amps after one time interval, 99 amps after two time intervals and 99.9 amps after three time intervals.
Average (Input Pulse Accumulations):	When applied to Input Pulse Accumulations, the "Average" refers to the block (fixed) window average value of the input pulses.
Average (Power):	When applied to power values (watts, VARs, VA), the average is a calculated value that corresponds to the thermal average over a specified time interval. The interval is specified by the user in the meter profile. The interval is typically 15 minutes. So, the Average Watts is the thermal average of watts over the previous 15-minute interval. The thermal average rises to 90% of the actual value in each time interval. For example, if a constant 100kW load is applied, the thermal average will indicate 90kW after one time interval, 99kW after two time intervals and 99.9kW after three time intervals.
Bit:	A unit of computer information equivalent to the result of a choice between two alternatives (Yes/No, On/Off, for example). Or, the physical representation of a bit by an electrical pulse whose presence or absence indicates data.
Binary:	Relating to a system of numbers having 2 as its base (digits 0 and 1).
Block Window Avg: (Power)	The Block (Fixed) Window Average is the average power calculated over a user-set time interval, typically 15 minutes. This calculated average corresponds to the demand calculations performed by most electric utilities in monitoring user power demand. (See Rolling Window Average.)

Byte:	A group of 8 binary digits processed as a unit by a computer (or device) and used especially to represent an alphanumeric character.
CBEMA Curve:	A voltage quality curve established originally by the Computer Business Equipment Manufacturers Association. The CBEMA Curve defines voltage disturbances that could cause malfunction or damage in microprocessor devices. The curve is characterized by voltage magnitude and the duration which the voltage is outside of tolerance. (See ITIC Curve.)
Channel:	The storage of a single value in each interval in a load profile.
Cold Load Pickup	This value is the **delay** from the time control power is restored to the time when the user wants to resume demand accumulation.
CRC Field:	Cyclic Redundancy Check Field (Modbus communication) is an error checksum calculation that enables a Slave device to determine if a request packet from a Master device has been corrupted during transmission. If the calculated value does not match the value in the request packet, the Slave ignores the request.
CT (Current) Ratio:	A Current Transformer Ratio is used to scale the value of the current from a secondary value up to the primary side of an instrument tranformer.
Cumulative Demand:	The sum of the previous billing period maximum demand readings at the time of billing period reset. The maximum demand for the most recent billing period is added to the previously accumulated total of the maximum demands.
Demand:	The average value of power or a similar quantity over a specified period of time.
Demand Interval:	A specified time over which demand is calculated.
Display:	User-configurable visual indication of data in a meter.
DNP 3.0:	A robust, non-proprietary protocol based on existing open standards. DNP 3.0 is used to operate between various systems in electric and other utility industries and SCADA networks.
EEPROM:	Nonvolatile memory. Electrically Erasable Programmable Read Only Memory that retains its data during a power outage without need for a battery. Also refers to meter’s FLASH memory.
Energy Register:	Programmable record that monitors any energy quantity. Example: Watthours, VARhours, VAhours.
Ethernet:	A type of LAN network connection that connects two or more devices on a common communications backbone. An Ethernet LAN consists of at least one hub device (the network backbone) with multiple devices connected to it in a star configuration. The most common versions of Ethernet in use are 10BaseT and 100BaseT as defined in IEEE 802.3 standards. However, several other versions of Ethernet are also available.

Flicker:	Flicker is the sensation that is experienced by the human visual system when it is subjected to changes occurring in the illumination intensity of light sources. IEC 61000-4-15 and former IEC 868 describe the methods used to determine flicker severity.
Harmonics:	Measuring values of the fundamental current and voltage and percent of the fundamental.
Heartbeat Pulse:	Energy indicator on the face of the Nexus® 1250/1252 meter; pulses are generated per the programmed K_e value.
I^2T Threshold:	Data will not accumulate until current reaches programmed level.
Integer:	Any of the natural numbers, the negatives of those numbers, or zero.
Internal Modem:	An optional modem within the meter's enclosure that connects to the RJ-11 telephone connector.
Invalid Register:	In the Nexus® meter's Modbus Map there are gaps between Registers. For example, the next Register after 08320 is 34817. Any unmapped Register stores no information and is said to be invalid.
ITIC Curve:	An updated version of the CBEMA Curve that reflects further study into the performance of microprocessor devices. The curve consists of a series of steps but still defines combinations of voltage magnitude and duration that will cause malfunction or damage.
K_e:	kWh per pulse; i.e. the energy.
kWh:	Kilowatt hours; kW x demand interval in hours.
KYZ Output:	Output where the rate of changes between 1 and 0 reflects the magnitude of a metered quantity.
LCD:	Liquid Crystal Display.
LED:	Light Emitting Diode.
Maximum Demand:	The largest demand calculated during any interval over a billing period.
Modbus ASCII:	Alternate version of the Modbus protocol that utilizes a different data transfer format. This version is not dependent upon strict timing, as is the RTU version. This is the best choice for telecommunications applications (via modems).

Modbus RTU:	The most common form of Modbus protocol. Modbus RTU is an open protocol spoken by many field devices to enable devices from multiple vendors to communicate in a common language. Data is transmitted in a timed binary format, providing increased throughput and therefore, increased performance.
Network:	A communications connection between two or more devices to enable those devices to send and receive data to one another. In most applications, the network will be either a serial type or a LAN type.
NVRAM:	Nonvolatile Random Access Memory is able to keep the stored values in memory even during the loss of circuit or control power. High speed NVRAM is used in the Nexus® meter to gather measured information and to insure that no information is lost.
Optical Port:	A port that facilitates infrared communication with a meter. Using an ANSI C12.13 Type II magnetic optical communications coupler and an RS232 cable from the coupler to a PC, the meter can be programmed with Communicator EXT software.
Packet:	A short fixed-length section of data that is transmitted as a unit. Example: a serial string of 8-bit bytes.
Percent (%) THD:	Percent Total Harmonic Distortion. (See THD.)
Protocol:	A language that will be spoken between two or more devices connected on a network.
PT Ratio:	Potential Transformer Ratio used to scale the value of the voltage to the primary side of an instrument transformer. Also referred to as VT Ratio.
Pulse:	The closing and opening of the circuit of a two-wire pulse system or the alternate closing and opening of one side and then the other of a three-wire system (which is equal to two pulses).
Q Readings:	Q is the quantity obtained by lagging the applied voltage to a wattmeter by 60 degrees. Values are displayed on the Uncompensated Power and Q Readings screen.
Quadrant: (Programmable Values and Factors on the Nexus® Meter)	Watt and VAR flow is typically represented usng an X-Y coordinate system. The four corners of the X-Y plane are referred to as quadrants. Most power applications label the right hand corner as the first quadrant and number the remaining quadrants in a counter-clockwise rotation. Following are the positions of the quadrants: 1st - upper right, 2nd - upper left, 3rd - lower left and 4th - lower right. Power flow is generally positive in quadrants 1 and 4. VAR flow is positive in quadrants 1 and 2. The most common load conditions are: Quadrant 1 - power flow positive, VAR flow positive, inductive load, lagging or positive power factor; Quadrant 2 - power flow negative, VAR flow positive, capacitive load, leading or negative power factor.

Register:	An entry or record that stores a small amount of data.
Register Rollover:	A point at which a Register reaches its maximum value and rolls over to zero.
Reset:	Logs are cleared or new (or default) values are sent to counters or timers.
Rolling Window Average (Power):	The Rolling (Sliding) Window Average is the average power calculated over a user-set time interval that is derived from a specified number of sub-intervals, each of a specified time. For example, the average is calculated over a 15-minute interval by calculating the sum of the average of three consecutive 5-minute intervals. This demand calculation methodology has been adopted by several utilities to prevent customer manipulation of kW demand by simply spreading peak demand across two intervals.
RS232:	A type of serial network connection that connects two devices to enable communication between devices. An RS232 connection connects only two points. Distance between devices is typically limited to fairly short runs. Current standards recommend a maximum of 50 feet but some users have had success with runs up to 100 feet. Communications speed is typically in the range of 1200 bits per second to 57,600 bits per second. RS232 connection can be accomplished using Port 1 of the Nexus® 1250/1252 meter.
RS485:	A type of serial network connection that connects two or more devices to enable communication between the devices. An RS485 connection will allow multi-drop communication from one to many points. Distance between devices is typically limited to around 2,000 to 3,000 wire feet. Communications speed is typically in the range of 120 bits per second to 115,000 bits per second.
Sag:	A voltage quality event during which the RMS voltage is lower than normal for a period of time, typically from 1/2 cycle to 1 minute.
Secondary Rated:	Any Register or pulse output that does not use any CT or VT Ratio.
Serial Port:	The type of port used to directly interface with a PC.
Swell:	A voltage quality event during which the RMS voltage is higher than normal for a period of time, typically from 1/2 cycle to 1 minute.
TDD:	The Total Demand Distortion of the current waveform. The ratio of the root-sum-square value of the harmonic current to the maximum demand load current. (See equation below.) **NOTE:** The TDD displayed in the Harmonics screen is calculated by Communicator EXT software, using the Max Average Demand..

$$I\,TDD = \frac{\sqrt{I_2^2 + I_3^2 + I_4^2 + I_5^2 + \cdots}}{I_L} \times 100\%$$

THD:	Total Harmonic Distortion is the combined effect of all harmonics measured in a voltage or current. The THD number is expressed as a percent of the fundamental. For example, a 3% THD indicates that the magnitude of all harmonic distortion measured equals 3% of the magnitude of the fundamental 60Hz quantity. The %THD displayed is calculated by your Nexus® meter.
Time Stamp:	A stored representation of the time of an event. Time Stamp can include year, month, day, hour, minute and second and Daylight Savings Time indication.
TOU:	Time of Use.
Uncompensated Power:	VA, Watt and VAR readings not adjusted by Transformer Loss Compensation.
V^2T Threshold:	Data will stop accumulating when voltage falls below programmed level.
Voltage Imbalance:	The ratio of the voltage on a phase to the average voltage on all phases.
Voltage Quality Event:	An instance of abnormal voltage on a phase. The events the meter will track include sags, swells, interruptions and imbalances.
VT Ratio:	The Voltage Transformer Ratio is used to scale the value of the voltage to the primary side of an instrument transformer. Also referred to as PT Ratio.
Voltage, Vab:	Vab, Vbc, Vca are all Phase-to-Phase voltage measurements. These voltages are measured between the three phase voltage inputs to the meter.
Voltage, Van:	Van, Vbn, Vcn are all Phase-to-Neutral voltages applied to the monitor. These voltages are measured between the phase voltage inputs and Vn input to the meter. Technologically, these voltages can be “measured” even when the meter is in a Delta configuration and there is no connection to the Vn input. However, in this configuration, these voltages have limited meaning and are typically not reported.
Voltage, Vaux	This is the fourth voltage input measured from between the Vaux and Vref inputs. This input can be scaled to any value. However, the actual input voltage to the meter should be of the same magnitude as the voltages applied to the Va, Vb and Vc terminals.